MEMOIRS

OF THE

NATIONAL MUSEUM,

MELBOURNE.

No. 7.

PUBLISHED BY ORDER OF THE TRUSTEES.

By Authority:
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TERMITES FROM THE AUSTRALIAN REGION.—PART I.

By Gerald F. Hill, Entomologist, National Museum, Melbourne.

(Plates I.–IX.)

A.—Introduction .. ..

B.—The Termite Fauna of New Guinea, New Britain, New Ireland, New Hebrides, and Solomon Islands .. ..

C.—A Revision of the Australian *Leucotermes*, *Microcerotermes* and *Mirotermes* .. ..

A.—INTRODUCTION.

The termites referred to in this paper comprise part of a collection of about 1,000 nest series collected by the author in the Northern Territory of Australia during the years 1912–17, in North Queensland during 1919–23, and in New Britain and Papua during 1922, in addition to about 250 series collected by Mr. J. Clark in Western Australia, and about 50 series collected by several other correspondents in various localities. Small collections from New Britain, New Ireland, and Solomon Islands, which have been presented to the National Museum recently by Drs. G. M. Heydon, H. G. Wallace, and Mr. W. W. Froggatt, as well as loan collections from the museums of South Australia, Queensland, and Western Australia, and Mr. L. J. Newman, Government Entomologist, Western Australia, have been dealt with also.

Thirty-two species, representing seven genera, are proposed as new, and of the former thirteen species, representing five genera, are from New Guinea, Bismarck Archipelago, and adjacent groups of islands. Descriptions are given also of the imago of one species from New Guinea and seven species from Australia, which have been known hitherto only in the sterile castes.

The nomenclature used in describing wing veins is that of Holmgren (1909, pp. 122–128), while the method of recording measurements and colours is the same as in my earlier papers. For the minute star and scale like structures found on the wings of most termites I have employed the term *micraster* (Tillyard, 1919)

FOOTNOTE.—While the above paper was in course of publication Dr. T. E. Snyder's paper on "New Termites from the Solomon Islands and Santa Cruz Archipelago" (Journ. Wash. Acad. Sc. xv. (17 and 19) 1925) came to hand. This contains descriptions of species from the former locality which appear to be very closely allied to, if not identical with, certain species now being dealt with. It is proposed to publish some revisional notes, if found necessary, after a comparison of the type series has been made.

to distinguish them from the more typical microtrichia with which they are generally associated. In recording localities "German New Guinea" is used to denote the former German territory on the New Guinea mainland.

I am indebted to Professors Nils Holmgren, Yngve Sjöstedt, S. F. Light, Mr. W. W. Froggatt, and the authorities of the South Australian and West Australian Museums for the opportunity of examining types and co-types of other authors, and to the first-named for the examination of specimens and the gift of literature not otherwise accessible to me. Professor Silvestri's assistance in the identification of south-west Australian species not represented in the West Australian Museum is gratefully acknowledged. Mr. J. A. Kershaw, Curator of the National Museum of Victoria, has facilitated the preparation of this paper in every possible manner; his co-operation has been whole-hearted and indispensable, and is acknowledged with gratitude. I thank Mr. J. Clark and many other correspondents for the patience and labour they have expended in procuring specimens for study, and Mr. Ewen Mackinnon for very kindly preparing the photomicrographs of wings.

B.—THE TERMITE FAUNA OF NEW GUINEA, NEW BRITAIN, NEW IRELAND, NEW HEBRIDES, AND SOLOMON ISLANDS.

So little attention has been paid to the termite fauna of New Guinea and the islands referred to in this paper that little advantage is to be gained from a discussion of the distribution of genera and species within these possessions or from a comparison with the fauna of the Australian continent; it may be mentioned, however, that of the seven genera recorded from the first group of localities six are well represented in Australia. The remaining genus (*Capritermes*), which is represented in Formosa, India, Africa, and South America, has not been recorded from this continent. On the other hand, of the thirteen genera represented in Australia *Mastotermes*, *Stolotermes*, *Porotermes*, *Leucotermes*, *Parrhinotermes*, *Hamitermes*, and *Ahamitermes* are not known from New Guinea and the above-mentioned islands.

List of termites from New Guinea, New Britain, New Ireland, New Hebrides, and Solomon Islands, including thirteen new species described in this paper: —

Species.	Locality.	Described Castes.		
		Imago.	Soldier.	Worker.
Calotermes (*Neotermes*) *papua* (Desn.) ..	German New Guinea	×*	×	..
,, ,, *schultzei* Holmgr. ..	,, ,,	×†	×†	..
,, ,, *ferrugineus* Holmgr. ..	,, ,,	×	..	..
,, (*Procryptotermes*) *speiseri* Holmgr. ..	New Hebrides ..	..	×	..
,, (*Cryptotermes*) *gulosus*, n. sp. ..	Papua ..	×*	×*	..
,, ,, *repentinus*, n. sp. ..	New Britain ..	×*	..	..
,, (*Glyptotermes*) *rantholabrum*, n. sp.	,, ..	×*	..	..
Coptotermes disae (Desn.)	German New Guinea	×†	..	..
,, *hyaloaper* Holmgr.	,, ,,	..	×	..
,, *remotus*, n. sp.	New Ireland ..	..	×*	×*
,, *obiratus*, n. sp.	New Britain and Papua	..	×*	×*
,, *solomonensis*, n. sp.	Solomon Islands	..	×*	×*
Rhinotermes dimorphus (Desn.)	German New Guinea	..	×†	×
,, ,, Sub-sp. *robustior* (Silv.)	Bismarck Archipelago	..	×	×
,, *celebensis* Holmgr.	German New Guinea, Celebes, and Sumatra	×	..	..
,, *translucens* Hav.	German New Guinea and Borneo	×	×	×
,, *umbraticus*, n. sp.	New Britain ..	×*	×*	×*
Eutermes grallator (Desn.)	German New Guinea	..	×	×
,, *princeps* (Desn.)	,, ,,	×†	×†	×
,, *gracilirostris* (Desn.)	,, ,,	..	×†	×
,, *novarum hebridarum* Holmgr. ..	New Hebrides ..	×	..	..
,, *rufirostris*, n. sp.	New Britain ..	..	×*	×*
,, *yandiniensis*, n. sp.	Solomon Islands, New Hebrides, New Britain, New Ireland	×*	×*	×*
,, *kaewiengensis*, n. sp.	New Ireland ..	×*	×*	×*
,, *vernoni* Hill	N. Queensland and Papua	×†	×†	×†
Mierocerotermes biroi (Desn.)	German and Dutch New Guinea and Papua	×	×	×
,, ,, sub-sp. *brevior* (Desn.) ..	German New Guinea	×	×†	×†
,, *papuanus* Holmgr.	,, ,,	×	×	×
,, *umbritarsus*, n. sp.	New Britain ..	×*	×*	×*
,, *repugnans*, n. sp.	Papua ..	..	×*	×*
,, *froggatti*, n. sp.	Solomon Islands	×*	×*	×*
Capritermes schultzei Holmgr.	German New Guinea	..	×	×
Mirotermes odontomachus (Desn.)	,, ,,	×†	×†	×

* Described in this paper. † Type or co-types examined.

Calotermes (Neotermes) papua Desneux.

Ann. Mus. Nat. Hungarici, Vol. iii, 1905. Holmgren, Neu-Guinea Termiten, 1911.

Plate I., figs. 1–4; Plate V., fig. 150.

Imago.

Colour.—Head, anterior three-fourths of pronotum and the abdomen auburn; posterior fourth of pronotum and apical margin of abdominal tergites 2–6 darker; meso- and metanotum, first abdominal tergite, tibiae, tarsi and sternites dark brown; remainder of ventral surface and wings Brussels brown; the whole insect glabrous and sparsely clothed with fine, pale-coloured setae.

Head (Fig. 1).—Twice as long as wide, front slightly concave and rugose, with very scanty moderately long pale setae. Eyes large, nearly circular (0·513 x 0·570), prominent and coarsely facetted, separated from the lower (lateral) margin of the head by a space equal to half their height. Ocelli large, broadly oval, contiguous to the eyes. Postclypeus short, three times wider than long, with four moderately long and stout reddish setae; the articulation of the mandibles forming a dark reddish-brown spot at either end. Anteclypeus four times wider than long, anterior margin truncate, yellow ochre in colour. Labrum brown, narrow at the base, rounded on the sides to the truncate apex, one-third wider than long, with scanty small pale setae. Antennae 17- or 18-jointed, the 1st joint short and broad, narrowed in the middle; 2nd half as long as 1st, its widest part (apex) as wide as narrowest part of 1st; 3rd about as long as 2nd, but narrower at the base and wider at the apex; 4th nearly as wide as the 3rd, but much shorter, globose; 5th to 15th increasing in length progressively; 16th and 17th equal in length to 15th, but narrower; 18th markedly shorter and narrower than 17th, narrowest of all; the 1st and 2nd joints with only minute hairs; the 3rd to 8th with a single row of large hairs near the apex.

Thorax.—Pronotum not markedly arched transversely, the margins produced, anterior margin concave, sides slightly rounded, antero- and postero-lateral angles rounded, posterior margin slightly emarginate in the middle, the entire surface uniformly and very scantily clothed with setae similar to those on head. Meso- and metanotum with posterior margin as in pronotum. Stumps of the forewings large, showing the bases of the veins very distinctly, covering two-thirds of the stumps of the hindwings; setae as on pronotum; stumps of the hindwings small and reaching only halfway down the metanotum.

Wings (Fig. 150).– With the anterior margin (excepting at the proximal end) ciliate, a few hairs on principal veins, none on membrane or small veins; the four anterior veins and their branches very distinct throughout their length; the media connected with the radial sector by many stout cross-veins; the cubitus distinct only to the sixth or seventh branch, from thence onward its course and the course of its remaining branches (seven to nine in number) is indicated by irregular lines of scale-like microsters similar to those on membrane; between the media and the cubitus there is a network of these lines arising from the former and extending more or less distinctly to the latter, most distinct in the forewings, somewhat obscure in the hindwings. In the hindwings the media sometimes branches from the radial sector a considerable distance from the cross-suture, which is markedly concave in the forewings.

Legs.– Short and stout, femora not markedly thickened; tibiae and tarsi dark coloured, tibial spurs long and slender.

Abdomen.– Widest in the middle, tapered to the markedly pointed apex; the apex of each tergite fringed with minute pale setae, a thin line of larger ones parallel to these at the apical third of each tergite; cerci large.

Measurements.—

	mm.		
Length with wings	♂ 18·00	♀	17·00
,, without wings	♂ 8·00	♀	7·00
Head, base to apex of labrum, long	♂ 2·16		
,, base to clypeofrontal suture, long	1·70		
,, (including eyes), wide ..	1·80		
Antennae, long	2·35–2·50		
Pronotum, long	1·02		
,, wide	1·80		
Wings, forewings, long	12·50–13·00		
,, ,, wide	3·50–3·75		
,, hindwings, long	12·00–12·75		
,, ,, wide	3·25–4·00		
Tibia iii, long	1·60		
Abdomen, wide	2·25		

Soldier.

Colour.—Antennae, labrum and dorsal surface of head orange rufous; frons and ventral surface ochraceous orange; anteclypeus hyaline suffused with orange; base of mandibles, the external articulation of mandibles and antennal carinae very dark; pronotum yellow ochre narrowly margined with brown; tibiae and tarsi

brown ; the whole insect glabrous and bearing very few moderately long fine setae ; margins of the nota with a scanty fringe of minute setae.

Head.—Widest in the middle, slightly rounded on the sides, very broadly rounded behind, frons concave and slightly rugose, sloping gradually to the clypeus. Clypeus short, three-fifths the width of the head at its widest part ; anteclypeus as wide as the labrum, truncate in front. Labrum markedly convex, rounded in front and on the sides, one-third wider than long, with five or six moderately long slender setae. Mandibles (Fig. 2) long and stout, the left with two angular teeth near the apex and several smaller ones towards the base ; the right with a short broad tooth in the middle and another near the base. Gula very narrow in the middle, where it is one-eighth to one-ninth as wide as the head. Eyes hyaline, rudimentary, situated immediately behind the antennal fossae. Antennae (Fig. 3) 14- to 17-jointed, generally 15-jointed ; the 1st one-third longer than wide at the apex, narrowed in the middle ; 2nd half as long as 1st, nearly as wide as long ; 3rd as long and wide as 2nd, narrowed at the base ; 4th a little narrower than 3rd, shortest of all ; 5th a little longer than 4th, as wide as 3rd ; 6th and 7th as wide as, and a little longer than, 5th, globose ; 8th to 13th moniliform, slightly turbinate ; 14th to 17th becoming narrower progressively ; 17th very short.

Thorax.—Pronotum (Fig. 4) a little narrower than head, anterior and posterior margins almost truncate, the sides rounded.

Legs.—Moderately stout, femora not markedly thickened, claws and tibial spurs long and slender. Styli present in all (30) specimens examined.

Measurements.—

	mm.
Total length	12·00
Head to apex of mandibles, long	5·13–5·25
.. to articulation of mandibles, long	3·50–3·70
Mandibles (dissected out), long	2·00
Head, wide	2·55–2·85
.. deep	1·76–1·93
Antennae, long	2·50
Pronotum, long	1·14–1·20
.. wide	2·40–2·50
Tibia iii, long	1·50
Abdomen, wide	2·25

NYMPHAE.

Colour.—Uniform light yellow ochre ; wing rudiments very little darker than remainder of insect.

Locality.—New Britain, Rabaul.

Biology.—Described from a large colony found in the trunk of a dead cacao tree in a dense tropical scrub in ravine (G.F.H., 1.6.22). Several living trees of the same species were similarly infested. I have referred my specimens to Desneux's species with some hesitation. There is a marked difference (3·00 mm.) in the length of the body and a considerable difference in the width of the head in the soldiers (the only caste in which *C. papua* is known), but there are no important structural characters mentioned in Desneux's description to differentiate the New Guinea from the New Britain examples. In view of the probability that a comparison of images will reveal specific differences not evident in the soldier caste, I have described the New Britain specimens in detail. I am indebted to Professor Holmgren for examining my material and for co-types of the allied species *C. schultzei* Holmgr. from Sepik, New Guinea.

CALOTERMES (NEOTERMES) SCHULTZEI Holmgren.

Neu-Guinea Termiten, 1911.

Locality.—German New Guinea.

CALOTERMES (NEOTERMES) FERRUGINEUS Holmgren.

Neu-Guinea Termiten, 1911.

Locality.—German New Guinea.

CALOTERMES (PROCRYPTOTERMES SPEISERI K. and N. Holmgren.

Nova Caledonia, Zoologie, Vol. ii, L. ii, No. 6.

Locality.—New Hebrides.

CALOTERMES (CRYPTOTERMES) GULOSUS, n. sp.

Plate I., figs. 5–11 ; Plate V., fig. 151 ; Plate VIII., fig. 152.

IMAGO.

Colour.—Ochraceous tawny above, legs and under surface honey yellow.

Head (Fig. 5).—Small, shagreened, much longer than wide, with scattered setae. Eyes large (0·323 x 0·255 to 0.306 x 0·272), moderately prominent. Ocelli large, but not prominent, very close to eyes. Clypeus one-fifth as long as wide, truncate in front, straight on the sides. Labrum markedly convex, large, rounded in front and on sides. Antennae (Figs. 6 and 7) very long, 15- or 16-jointed, the basal joints short. 6th to 14th increasing progressively.

Thorax.—Pronotum reniform, the margin with a scanty fringe of small fine setae.

Wings (Fig. 151).—The principal veins dark brown, very distinct, the smaller veins somewhat obscure; membrane (Fig. 152) with minute scale-like microasters, most evident on the veins. Stumps of hindwings less than half as long as those of forewings.

Legs.—Short and stout; femora thickened, nearly half as wide as long, spurs long and markedly serrate.

Abdomen.—Long and narrow, almost without setae, except on the apical margin of sclerites, where there is a fringe of hairs similar to those on pronotum. Cerci very short and stout.

Measurements.—	mm.
Length, with wings	9·25 – 9·50
,, without wings	4·50 – 4·80
Head, from base to apex of labrum, long ..	1·20
,, from base to clypeofrontal suture, long	0·90
,, wide	0·95 – 1·00
,, deep	0·50
Gula, at middle of head, wide	0·18 – 0·23
Pronotum, long	0·61
,, wide	1·19
Wings, long	6·75
,, wide	2·10
Tibia iii, long	0·80

Queen.

Total length, 5·00; abdomen, wide, 1·25.

Soldier.

Colour.—Anterior part of head and mandibles black, the former shading to hessian brown posteriorly; lateral cervical sclerites, anterior lobes of pronotum, a spot on either side of these and another in the middle line at the posterior third also hessian brown.

Head (Figs. 8 and 9).—Short, broad, and high, broadest behind the middle; frontal area excavated, rugose: lateral and dorsal margins of this area thickened and bent outwards and upwards to form a flange, which is deeply and narrowly notched mid-dorsally: a short, stout, horn-like prolongation of the lower anterior margin of the antennal fossa projects outwards and upwards well beyond the frons. Mandibles short and stout. Labrum wide at the base, bluntly pointed in front. Antennae (Fig. 11) 13-jointed; the 4th very short and wide, wider than 3rd; 5th, 6th, and 7th progressively longer and wider; 8th to 13th moniliform.

Thorax (Fig. 10).—Pronotum with anterior lobes elevated, the sides depressed, very little narrower than head, middle two-thirds

of anterior margin serrated, anterolateral corners rounded, sides slightly curved, posterior margin slightly sinuate, a scanty fringe of setae on margin, few elsewhere; posterior margin of meso- and metanotum rather more sinuate than pronotum.

Legs.—Short and very stout, femora greatly thickened, nearly half as wide as long; spurs markedly serrate.

Abdomen.—Short and wide, with short pale setae at the apex of each sclerite: longer on the last three segments. Cerci short and stout.

Measurements.—

	mm.
Total length (head at right angles to body)	3·90
Thorax and abdomen, long	3·00
Head, base to anterior margin of frontal flange, long	1·20–1·25
,, to apex of mandibles, long	1·62
,, wide	1·20
,, deep	0·90
Antennae, long	1·00
Pronotum, long	0·78
,, wide	1·14
Tibia iii, long	0·65
Abdomen, wide	1·00

Locality.—Papua, 30 miles south-east from Port Moresby.

Described from numerous alate imagos, two kings, two queens, one soldier, and many larvae and nymphs: found in association with soldiers and workers of *Microcerotermes repugnans*, n. sp., in a rotten log (G.F.H., 22.7.22).

Affinities.—The imago is very closely allied to *C. primus* Hill, from North Queensland; the latter, however, has longer and lighter coloured wings and differently shaped pronotum (cf. Figs. 5 and 12). The soldiers of these two species are quite distinct in the form of the head and pronotum. The soldier resembles *C. cynocephalus* Light, from Philippine Islands, but it is much larger and has the frontal flange distinctly differently notched.

Types (imago, soldier, and worker) in National Museum of Victoria.

Calotermes (Cryptotermes) repentinus, n. sp.

Plate I., fig. 13.

Imago.

Very closely allied to *C. gulosus*, n. sp., from which it is distinguished by its smaller size, narrower gula, differently shaped, and less setaceous pronotum (Fig. 13), shorter and narrower wings.

Measurements.—	mm.
Length, with wings	8·00
,, without wings	4·00
Head, from base to apex of labrum, long	1·10
,, wide	0·87
Gula, wide	0·12
Pronotum, long	0·56
,, wide	0·85
Wings, long	6·00
,, wide	1·50
Tibia iii, long	0·78

Locality.—New Britain: Rabaul (type locality), and Toma. G.F.H., June, 1922.

Described from two alate imagos (♂ and ♀) caught in spiders' webs under roof of bungalow.

Type in National Museum of Victoria.

Calotermes (Glyptotermes) xantholabrum, n. sp.

Plate V., fig. 153; Plate VIII., fig. 154.

Imago.

Colour.—Upper and lower surfaces very dark brown, nearly black; basal joints of antennae Dresden brown; remainder of antennae, femora, base of mandibles and apex of abdomen dark chestnut brown; tibiae and tarsi whitish.

Head.—Very small, shagreened, with very few setae, these mostly short, fine, and pale. Eyes small (0·204 x 0·255), finely facetted, rather prominent. Ocelli small, close to eyes. Clypeus hyaline, short and comparatively narrow, anterior margin produced in the middles, posterior margin straight. Labrum small, nearly parallel on the sides and almost truncate in front, with a few moderately long setae near the apex. Antennae 11- or 12-jointed, the 2nd and 3rd joints equal, 4th a little shorter and wider, 5th to 10th or 11th moniliform.

Thorax.—Pronotum short and wide, reniform, markedly convex when viewed from behind, the margin with scanty fringe of pale, short setae; two pairs of long setae about the middle, one pair near the median line, the other near the lateral margins: an obscure notch in the posterior margin and a distinct median line from anterior to posterior border. Mesonotum slightly sinuate posteriorly; metanotum more rounded.

Wings (Figs. 153, 154).—Short and very narrow, iridescent, superficially like those of *Cryptotermes albipes* Holmgr. Forewing

with subcosta very short or completely fused with costa; radius less than one-fourth the length of wing; radial sector and media stout, like costa, close together, unbranched, parallel to each other and to costa; cubitus passing through middle of wing, with about five well-defined branches near base and numerous others towards apex indicated by rows of micrasters. Hindwing similar, excepting that the media branches from the radial sector about the proximal one-fourth of wing. Membrane light brown, suffused with darker brown in anal area; micrasters moderately numerous, bluntly conical, apparently with pore at apex.

Legs.—Short; femora greatly thickened, almost without setae; tibiae with scattered setae and short stout spurs.

Abdomen.—Nearly parallel on the sides, bluntly rounded behind, each tergite with a fringe of short pale setae at the apex, similar to that on pronotum. Cerci short and stout.

Measurements.—

	mm.
Length, with wings (♂)	6·40
,, without wings	4·00
Head, from base to clypeofrontal suture, long ..	0·74
,, from base to apex of labrum, long	1·08
,, wide	0·85
Antennae (12-jointed), long	0·85
Pronotum, long	0·62
,, wide	0·74
Wings, forewings, long	4·21
,, ,, wide	1·08
,, hindwings, long	4·10
,, ,, wide	1·14

Locality.—New Britain: Rabaul.

Described from two alate imagos (♂ and ♀) taken from a spider's web under bungalow roof (G.F.H., 6.6.22).

Affinities.—This species differs from *Cryptotermes albipes* Holmgr., from Loyalty Islands, in having darker head and pronotum, shorter, narrower, and darker wings, smaller eyes, the labrum, head, pronotum and abdomen more setaceous, the setae much longer and darker, wing micrasters fewer, larger and darker, and in the subspecific character of the venation.

Type in National Museum of Victoria.

COPTOTERMES ELISAE (Desneux).

Ann. Mus. Nat. Hungarici, Vol. iii, 1905. Holmgren, Neu-Guinea Termiten, 1911.

Locality.—German New Guinea.

Coptotermes hyaloapex Holmgren.

Neu-Guinea Termiten, 1911.

Several soldiers collected from the interior of a house-stump are undoubtedly referable to this species. (Type locality Bukana, German New Guinea.)

Locality.—Papua: Mambare River, near former international boundary (Dr. G. H. Vernon, 1921).

Coptotermes remotus, n. sp.

Plate I., fig. 14.

Soldier.

Most closely allied to *C. michaelseni* Silv., from south-west Australia, from which species it is distinguished by its shorter, wider and more pyriform head (cf. Figs. 14 and 15); number and form of the antennal joints, shorter, wider and less acuminate labrum. Antennae 13-jointed, the 1st joint long, a little more than half as wide as long; 2nd, 3rd, and 4th about equal in length, a little more than half the length of 1st and one-fifth narrower, the 2nd cylindrical, the 3rd and 4th turbinate; 5th slightly longer and wider than fourth; 6th to 12th approximately equal, slightly longer than 5th; 13th a little longer than 12th and about as wide. Thorax and abdomen as in *C. michaelseni*, but more setaceous.

Measurements.—	*C. remotus.*	*C. michaelseni.*
Total length	3·50–3·75 ..	4·00–4·30
Head, with mandibles, long	1·70 ..	1·76
,, posterior margin to anterior margin of fontanelle, long ..	1·00 ..	1·14–1·20
,, wide	0·97 ..	0·85–0·96
Antennae	13-jointed ..	14-jointed
Pronotum, long	0·34 ..	0·34
,, wide	0·68 ..	0·68
Tibia iii, long	0·80 ..	0·80

Worker.

Colour.—Creamy white; labrum yellowish white, articulation of mandibles reddish. Head, thorax, and abdomen with scattered reddish setae.

Head.—Nearly spherical when viewed from above, flattened on vertex; clypeus short and wide, five times wider than long; anteclypeus short, truncate in front. Labrum large, narrowed at the

base, spreading out sharply at the basal fourth, then narrowed to the rounded apex. Antennae 14-jointed, the 1st joint long; 2nd and 3rd equal in length; 4th a little shorter and narrower, smallest of all; 5th slightly larger than 4th, more globose; 6th to 13th moniliform; 14th a little longer and narrower than 13th.

Measurements.—

	mm.
Total length	3·00
Head, base to apex of labrum, long	1·14
,, base to clypeofrontal suture, long	0·74
,, wide	0·97
Pronotum, long	0·34
,, wide	0·57
Tibia iii, long	0·74

Locality.—New Ireland: Kaewieng (Dr. H. G. Wallace, 4.10.23). Described from a small series of soldiers and workers. It is the smallest species at present known from the Australian region.

Types (soldier and worker) in National Museum of Victoria.

Coptotermes obiratus, n. sp.

Plate I., fig 16.

Soldier.

Colour.—Head yellow ochre; labrum orange rufous; thorax light orange yellow; legs and abdomen lighter than thorax.

Head (Fig. 16).—Long and narrow, not markedly widened posteriorly; with a few long reddish setae. Fontanelle small, half as wide as labrum, its margin dark and projecting very little. Clypeus short, hyaline. Labrum long, acuminate. Antennae long and slender, 16-jointed, the 2nd joint as long as the 5th, 3rd shortest and narrowest of all, 4th a little longer and wider than 3rd. Gula at its narrowest part 0·228, or about one-sixth as wide as head.

Thorax.—Pronotum deeply emarginate in front, not markedly so behind, with rather scanty long reddish setae. Mesonotum less sinuate posteriorly than pronotum: metanotum nearly straight: setae as on pronotum.

Legs.—Moderately long, stout, and setaceous.

Abdomen.—Without dark pattern mid-dorsally (as seen in *C. acinaciformis* Frogg.), setae on dorsum as on pronotum, denser on posterior part of ventral surface. Cerci very long and slender.

Measurements.—	mm.
Total length	5·50
Head, with mandibles, long	3·36
,, base to apex of labrum, long	2·00
,, base to frontal opening, long	1·53
,, wide	1·19–1·22
Antennae, long	1·70
Pronotum, long	0·51
,, wide	0·91
Mesonotum, wide	0·85
Metanotum, wide	0·75
Tibia iii, long	0·91

Worker.

Colour.—Head cinnamon buff; frons whitish; a small ferruginous spot at either end of postclypeus; labrum light orange yellow at the sides; remainder of insect whitish.

Head.—Large, widest part in line with antennal foveolae, narrowed posteriorly to the broadly rounded hind margin, rather scantily clothed with pale setae. Postclypeus small, anterior margin concave, posterior margin convex, about one-fourth as long as wide: anteclypeus abont as long as postclypeus, slightly produced in middle. Labrum small, wider than long, narrowed at the base, slightly widened before the middle, thence narrowed to bluntly pointed apex. Antennae 16-jointed, the 1st joint long and narrowed in the middle, 2nd about half as long as 1st, 3rd very small, 4th to 8th increasing in size progressively.

Thorax.—Pronotum deeply emarginate and bent up in front; posterior margin truncate; moderately setaceous. Posterior margin of mesonotum truncate, of the metanotum broadly rounded: with setae as on pronotum.

Legs.—Moderately stout; femora with few setae; much more numerous on tibae.

Abdomen.—Short, very wide in the middle, tapered to the bluntly pointed apex; with setae as on thorax. Cerci and styli long and slender.

Measurements.—	mm.
Total length	4·50
Head, from posterior margin to apex of labrum, long	1·53
,, to clypeofrontal suture, long	1·02
,, wide	1·25
Antennae, long	1·53
Pronotum, long	0·45
,, wide	0·85
Tibia iii, long	0·93
Abdomen, wide	0·91

Locality.—Papua (Mekeo District): Waima (type locality); New Britain: Rabaul.

Described from numerous soldiers and workers collected in native-made dwelling (G.F.H., July, 1922) from the rafters of which the insects had fallen during the night on to a mosquito-net below. When discovered next morning each of the soldiers had the mandibles firmly imbedded into the fabric forming the top of the net. The New Britain specimens were taken in the rafters of a native dwelling by Dr. G. M. Heydon.

Affinities.—This species is quite distinct from *C. hyalopyer* Holmgr. and from other species from the Australian region; it is apparently easily distinguished from Oriental species. There is a possibility that it is *C. elisae* Desn., from the Huon Gulf District of German New Guinea, at present known only in the alate form. It is an exceedingly destructive species, and undoubtedly the one responsible for most of the damage to native dwellings.

Types (soldier and worker) in National Museum of Victoria.

Coptotermes solomonensis, n. sp.

Soldier.

Very closely related to *C. obiratus*, n. sp., from which it is distinguished by the following characters:—Head dark in colour (mars yellow), a little less narrowed anteriorly, wider gula, 14-jointed antennae, larger fontanelle (0·170 wide); head, thorax, and abdomen noticeably less hairy.

Measurements.—

	mm.
Total length	5·40
Head, with mandibles, long	2·56
,, to apex of labrum, long	1·99
,, to anterior margin of fontanelle, long	1·36
,, wide	1·19
Gula, wide (at narrowest part)	0·285
Antennae, long	1·50
Pronotum, long	0·45–0·47
,, wide	0·91
Tibia iii, long	1·02
Abdomen, wide	1·20

Worker.

Closely allied to *C. obiratus*, n. sp., from which species it is differentiated by its darker head (ochraceous tawny); much larger ferruginous spot at end of clypens; smaller pronotum; 15-jointed antennae (3rd joint nearly always larger than 4th); markedly less hairy head, thorax, and abdomen.

Measurements.—	mm.
Total length	4·50
Head, from posterior margin to apex of labrum, long ..	1·48
,, to clypeofrontal suture, long	1·08
,, wide	1·27
Antennae, long	1·25
Pronotum, long	0·39
,, wide	0·74
Tibia iii. long	0·96

Locality.—Solomon Islands: Banaka.

Described from a small colony of workers and soldiers collected by Mr. W. W. Froggatt.

Types (soldier and worker) in National Museum of Victoria.

Rhinotermes dimorphus Desneux.

Ann. Mus. Nat. Hungarici, Vol. iii, 1905. Holmgren, Neu-Guinea Termiten, 1911.

Locality.—German New Guinea: Friedrich-Wilhelmshafen.

Rhinotermes dimorphus sub-sp. *robustior* (Silvestri).

Die Fauna Süd-west Australiens, Isoptera, ii, 17, 1909.

Two soldiers and several workers from New Ireland (Kaewieng, Dr. H. G. Wallace) agree with the description of this species, the type locality of which is Bismarck Archipelago (Ralum Louson).

Rhinotermes celebensis Holmgren.

Neu-Guinea Termiten, 1911; Kungl. sv. Vet. Akad. Handl. Bd. 46, No. 6, 1911.

Locality.—German New Guinea; Sumatra; Celebes.

Rhinotermes translucens Haviland.

Jr. Linn. Soc., Vol. xxvi., 169, 1898. Holmgren, Kungl. sv. Vet. Akad. Handl. Bd. 48, No. 6, 1911; Neu-Guinea Termiten, 1911.

Locality.—German New Guinea: Borneo.

Rhinotermes umbraticus, n. sp.

Plate I., figs. 17, 18.

King.

Colour.—Antique brown to Sudan brown; anterior margin of frons and apice of wing-stumps argus brown; under surface and legs antique brown; tarsi Sudan brown.

Head.—Large, hemispherical behind the eyes. Eyes small (0·323 x 0·391 diam.), slightly oblique, prominent, finely facetted, 0·136 from lower margin of head. Ocelli large, well separated from eyes, in line with fontanelle, their posterior margin a little behind a line drawn through the anterior margin of the eyes. Fontanelle large, circular, with prominent margins, sinuate fine furrows arising posterior to it and passing forward on either side of it into the frons. Frons convex, its antero-lateral margins well defined by the transverse suture, the posterior margin not so well defined but clearly extending to the fontanelle; clypeo-frontal suture straight. Clypeus triangular, two-fifths wider than long, the apex bluntly pointed and projecting markedly over the excavated anteclypeus, dark in colour, divided longitudinally by a distinct suture, which passes posteriorly into the frons. Anteclypeus hyaline. Labrum large, convex, slightly narrowed at the base, swollen on the sides, rounded in front. Antennae of doubtful number of joints, only 14 and 15 joints remaining in king and queen; the 2nd and 4th equal in length, the 2nd quadrate, the 4th globose; the 3rd markedly longer than 2nd and 4th; 5th a little longer than 4th; 4th to 14th moniliform.

Thorax.—Pronotum very large, slightly arched, the posterior and lateral margins raised, the anterior margin nearly straight, its extreme edge bent up, with an obscure depression in centre; the sides rounded, posterior margin slightly concave, a scanty fringe of long and medium sized setae on sides and behind, a few similar ones on remainder of surface. Wing-stumps very large, with scattered large golden setae; the base of the veins very distinct; the stumps of the forewings nearly covering those of the hindwings.

Legs.—Long and rather stout, with few setae, excepting on the outer edge of tarsi, where there is a rather dense fringe of long and moderately stout ones.

Abdomen.—Widest in the middle, bluntly rounded posteriorily; tergites with apical fringe of long golden setae like those on wing-stumps, others scattered irregularly behind these. Cerci long and moderately stout.

Measurements.—

	mm.
Total length—king	7·00
,, queen	7·50
Head, to apex of post-clypeus, long	1·42
,, to clypeofrontal suture, long	1·14
,, to fontanelle, long	0·85
,, deep	0·85
Pronotum, long	0·74
,, wide	1·20
Tibia iii, long	1·80
Abdomen, wide (king)	1·70

Soldier (Small Form).

Colour.—Head and pronotum raw sienna; labrum antique brown; legs cream colour.

Head (Fig. 17).—Short and wide, widest behind the antennal fossae, broadly rounded behind, with only three pairs of long slender setae (situated as shown in figure). Labrum of typical form; extending beyond mandibles.

Mandibles typical. Antennae 13-jointed (rarely 12-jointed), the 3rd shortest and narrowest. Palpi long, reaching to the apex of labrum.

Thorax (Fig. 18).—Pronotum small, anterior margin markedly convex and slightly elevated in the middle, sides rounded, posterior margin slightly sinuate, with three pairs of long slender setae, arranged one on either side of the middle line and near the anterior margin, one on each antero-lateral angle and one on each postero-lateral angle.

Legs.—Moderately stout; with scanty, long fine setae.

Abdomen.—Each tergite with six large setae like those on thorax; each sternite with about twelve shorter and paler ones. Cerci very long and slender.

Measurements.—	mm.
Total length	2·10
Head, with mandibles, long	1·10
,, to posterior margin of fontanelle, long	0·52
,, wide	0·56
Labrum, from anterior margin to clypeus, long	0·35
Pronotum, long	0·25
,, wide	0·37
Mesonotum, wide	0·37
Metanotum, wide	0·44
Antennae (13-jointed), long	0·96
Tibia iii, long	0·54
Abdomen, wide	0·68

Worker.

Colour.—Head buff yellow, with dark reddish spot at either end of clypeus.

Head.—Hemispherical, widest behind the antennal fossae, flattened on the vertex; with scanty moderately long and stout setae. Antennae 13- to 15-jointed, the 3rd and 4th more or less fused. Labrum convex, rounded on sides and in front; with a few long setae.

Thorax.—Pronotum very short; the anterior half elevated and margins rounded; posterior margin as in soldier.

Measurements.—

	mm.
Total length	4·00
Head, to apex of labrum, long	1·25
,, to clypeofrontal suture, long	0·62
,, wide	1·00
Pronotum, long	0·34
,, wide	0·51
Tibia iii, long	0·68

Locality.—New Britain : Bai, near Rabaul.

Described from a small colony comprising 54 individuals as follows :—King, queen, 16 soldiers, and 38 workers. Found in a rotton log (G.F.H., June, 1922), which contained also the colony of *Eutermes rufirostris*, n. sp., referred to elsewhere in this paper. The absence of soldiers of the large form in young colonies of *Rhinotermes* has been noted in Australian species.

Affinities.—The most closely related species appears to be *R. dimorphus*, the smaller soldier of which is larger than that of the proposed new species, and has at least two more joints in the antennae. The imago of Desneux's species is not known. The imago of *R. umbraticus* differs from all other species known to the writer in having a markedly protuberant postclypeus.

Types (imago, soldier, and worker) in National Museum of Victoria.

EUTERMES GRALLATOR (Desneux).

Ann. Mus. Nat. Hungarici, Vol. iii, 1905. Holmgren, Neu-Guinea Termiten, 1911.

Locality.—German New Guinea.

EUTERMES PRINCEPS (Desneux).

Ann. Mus. Nat. Hungarici, Vol. iii, 1905. Holmgren, Neu-Guinea Termiten, 1911.

Locality.—German New Guinea, Dutch New Guinea.

EUTERMES GRACILIROSTRIS (Desneux).

Ann. Mus. Nat. Hungarici, Vol. iii, 1905. Holmgren, Neu-Guinea Termiten, 1911.

Locality.—German New Guinea.

EUTERMES NOVARUM HEBRIDARUM Holmgren, N. & K.

Nova Caledonia, Zoologie, Vol. ii, L. ii, No. 6, 1915.

Locality.—New Hebrides.

Eutermes rufirostris, n. sp.

Plate I., figs. 19–21.

Soldier.

Colour.—Head buckthorn brown, rostrum burnt sienna ; antennae and pronotum nearly as dark as head ; legs cream buff.

Head (Figs. 19 and 20).—Almost spherical in dorsal aspect, with a few very long, and rather more very short setae ; rostrum long and slender. Antennae (Fig. 21) 11-jointed (rarely 10-jointed) ; 3rd shortest and narrowest, 4th markedly longer and wider than 3rd.

Pronotum.—Very small, less than half as wide as head, the antero-lateral angles prominent, the anterior margin slightly emarginate in the middle, the hind margin less so ; with very few hairs.

Legs.—Moderately short and stout, with scanty pale setae.

Abdomen.—Short and broad, widest in the middle, pointed towards the apex.

Measurements.—

	mm.
Total length	2·65
Head, long	1·10
,, wide	0·59
,, deep	0·42
Thorax and abdomen, long	1·53
Pronotum, long	0·11
,, wide	0·25
Antennae (11-jointed)	0·81
Tibia iii, long	0·56

Worker.

Colour.—Head and antennae buff yellow, articulation of mandibles showing distinctly as a reddish spot at either end of post-clypeus ; thorax and legs cream colour.

Head.—Widest behind the antennal fossae, sides narrowed to the posterior margin : frontal and transverse sutures indistinct ; frons concave ; setae few, pale, some comparatively long ; post-clypeus slightly concave behind, less so in front, three-eighths as long as wide ; anteclypeus rounded in front ; labrum short, markedly convex and rounded, clothed with long and short setae. Antennae 12-jointed, 2nd joint half as long as 1st and nearly as wide ; 3rd very short and markedly narrower than 2nd and 4th ; 4th to 7th increasing in length progressively.

Measurements.—

	mm.
Total length	2·50–2·75
Head, long	0·74
,, wide	0·68
Pronotum, wide	0·42
Tibia iii, long	0·51

Locality.—New Britain : Bai, near Rabaul.

Described from a small colony, comprising 6 soldiers and about 20 workers, found in a rotten log (G.F.H., 1922).

Affinities.—This species is easily distinguished from any New Guinea or Australian form, and it is quite distinct from any species from the Oriental region known to the writer from specimens or in literature.

Types (soldier and worker) in National Museum of Victoria.

Eutermes yandiniensis, n. sp.

Plate I., figs. 22–26 ; Plate V., fig. 157 ; Plate VIII., fig. 158.

Imago.

Colour.—Head dark brown, darker than pronotum ; thorax mummy brown, labrum buckthorn brown ; clypeus, palpi, and legs ochraceous tawny ; antennae a little darker ; tergites of abdomen mummy brown ; sternites Prout's brown, with large mummy brown patches laterally.

Head (Fig. 22).—Moderately setaceous, some of the setae very long ; rounded behind the eyes ; frons concave ; fontanelle small, inconspicuous, in line with the middle of the eyes ; ocelli very large (0·187 long), broadly oval, near but not touching the eyes ; eyes very large (0·510 x 0·460) and prominent, finely facetted, 0·342 from lower margin of head ; postclypeus small, short rounded behind, the posterior four-fifths moderately convex, with a few long and numerous short setae, anterior one-fifth flat ; labrum very small, moderately convex, widest in the middle, narrowed to the bluntly-pointed apex. Antennae 15-jointed, the 3rd joint as long as the 2nd and 5th, but narrower ; 4th and 6th as wide as long, longer and wider than 5th ; 7th to 11th equal, longer than 6th ; 12th to 15th equal, longer than 7th to 11th ; 9th to 14th turbinate.

Thorax (Fig. 23).—Pronotum nearly straight in front, anterior margin slightly bent up and emarginate in the middle, antero-lateral angles rounded to the slightly emarginate posterior margin : surface densely setaceous ; meso- and metanotum clothed densely with short and a few long setae ; the posterior margin less sinuate than pronotum.

Wings (Figs. 157, 158).—Wing-stumps clothed densely with moderately short and a few long setae; cross-suture straight. Wings brown, suffused with yellow behind the radial sector; the first five branches of the cubitus very distinct, the remainder clearly defined to their termination; membrane very setaceous and densely covered with minute micrasters.

Legs.—Moderately long and stout, not very setaceous.

Abdomen.—Widest in the middle, bluntly rounded behind, very setaceous. Cerci very short and broad at base.

Measurements.—

	mm.
Length, with wings	13·50–41·00
,, without wings	7·00–7·50
Head, from base to apex of labrum, long	1·42
,, from base to clypeofrontal suture, long	0·97
,, wide	1·40
Antennae, long	2·10
Pronotum, long	0·68
,, wide	1·20
Wings, forewings, long	10·50
,, ,, wide	3·30
,, hindwings, long	10·75
,, ,, wide	3·30
Tibia iii, long	1·60

Soldier.

Colour.—Head very dark brown, basal one-third generally with large area paler in colour, apical half of rostrum more reddish than basal half; antennae russet; anterior half of pronotum as dark as head, posterior half and also meso- and metanotum mummy brown; legs Dresden brown, rather paler than abdomen.

Head (Figs. 24 and 25).—Nearly straight on top; rostrum large, moderately stout, about one-third as long as remainder of head; a group of short hairs at tip of rostrum and a few long ones on antero-dorsal surface. Antennae (Fig. 26) 13-jointed, the 1st short, cylindrical, a little more than half as wide as long; 2nd as long as 1st is wide, narrowest at base; 3rd a little narrower than 2nd and very much longer, nearly as long as 1st; 4th as long as 2nd and as wide as 3rd; 5th longer and wider than 4th, shorter than 6th; 6th, 7th, and 8th equal, longer than 9th; 10th, 11th, and 12th equal, shorter than 9th; 7th to 12th turbinate; 13th as wide as 12th.

Thorax.—Pronotum small, the anterior margin rounded and slightly emarginate, very little elevated; posterior margin indistinctly emarginate; minute hairs on anterior margin, none on posterior margin and few elsewhere.

Legs.—Long and comparatively stout; with scanty setae, most numerous on tarsi, some very long ones at proximal end of femor and on trochantin.

Abdomen.—Large, widest in the middle, bluntly pointed at the apex; first two tergites with very long setae, a few only on each of the others; venter with rather scanty clothing of moderately long pale setae and about twelve very long ones distributed over last three or four sternites. Cerci very large.

Measurements.—	mm.
Total length	4·00
Head, long	1·42–1·52
,, wide	0·85–0·95
Pronotum, long	0·57–0·68
,, wide	1·70–1·82
Tibia iii, long	1·00–1·15
Abdomen, wide	1·00

WORKER.

Colour.—Head mars brown above, frons somewhat lighter, blotched; sides much lighter; frontal and transverse sutures pale coloured, very distinct; labrum raw sienna, its apex hyaline; clypeus buckthorn brown; pronotum cinnamon brown; meso- and metanotum and abdomen ochraceous tawny.

Head.—Small, widest across the middle, glabrous, with few setae, the latter comprising a few very long ones and rather more short ones; postclypeus moderately large, convex, more than twice as wide as long, truncate in front; anteclypeus very large, as long as postclypeus, middle of anterior margin bluntly pointed; labrum small, narrow behind, wide in the middle, rounded in front, with a few moderately long hairs near the apex. Antennae 14-jointed, the 3rd shortest and narrowest.

Thorax.—Pronotum small, anterior half more elevated than in soldier, otherwise similar.

Legs.—Long and moderately stout, clothed as in soldier.

Abdomen.—Large, widest in middle, clothed as in soldier. Cerci large.

Measurements.—	mm.
Total length	4·50
Head, base to apex of labrum, long	1·42
,, base to clypeofrontal suture, long	0·85
,, wide	1·19
,, deep	0·68
Pronotum, long	0·28
,, wide	0·68
Tibia iii, long	1·08
Abdomen, wide	1·45

Locality.—Bougainville Island (Solomon Group) : Yandini ; New Britain : Rabaul ; New Ireland : Kaewieng ; New Hebrides (from W. W. Froggatt's collection).

Described from (1) three alate imagos, numerous soldiers, and five workers collected at Yandini (type locality) during December, 1923, by Dr. G. M. Heydon, from blackish, rather brittle termitarium on trunk of tree ; (2) numerous soldiers and workers from a similar nest to above, Rabaul, G.F.H., 2.6.22 ; (3) soldiers and workers from covered-ways on tree trunk in dense jungle, Rabaul, G.F.H., 2.6.22 ; (4) soldiers and workers from covered-ways on tree trunk, Kaewieng, Dr. H. G. Wallace, 2.12.23. The New Britain, New Ireland, and New Hebrides series differ from the type series in having workers with lighter brown heads and soldiers with the lighter area at the back of the head much more conspicuous.

Affinities.—This species is allied to *E. princeps* (Desn.), from which it is easily distinguished by the size of the imagos and soldiers. It is allied to several undescribed species from Australia. *E. novarum hebridarum* Holmgr. is evidently a very distinct species.

Types (imago, soldier, and worker) in National Museum of Victoria.

Eutermes kaewiengensis, n. sp.

Plate I., figs. 27, 28 ; Plate V., fig. 159 ; Plate VIII., fig. 160.

Imago.

Colour.—Head very dark brown, nearly black ; pronotum, antennae, wing-stumps, and tergites of abdomen somewhat lighter ; palpi, legs, wings, meso- and metanotum mummy brown ; clypeus and labrum yellow ochre ; anteclypeus hyaline.

Head (Fig. 27).—Very hairy, hemispherical behind the eyes, sloping in sharply from the anterior margin of eyes to the clypeus. Fontanelle indistinct. Postclypeus short, one-fourth as long as wide, convex, rounded behind, truncate in front, clothed with numerous long reddish setae ; anteclypeus longer than postclypeus, anterior margin produced in the middle. Labrum short and broad, densely setaceous. Eyes large (0·289 diam.), circular, prominent, separated from lower margin of head by a space equal to that separating the ocelli from the eyes. Ocelli large, broadly oval. Antennae 13-jointed, the 1st joint twice as long as wide, cylindrical ; 2nd less than half as long as 1st, narrow ; 3rd as long as 2nd, narrowest of all ; 4th as long as 2nd and 3rd, globose ; 4th to 13th lengthening progressively.

Thorax.—Pronotum concave and elevated in front, antero-lateral angles rounded, sides narrowed sharply to the sinuate posterior margin ; a deep yellowish linear depression half as long as the

width of pronotum behind the anterior margin and a smaller rounded depression in each corner : the surface densely clothed with moderately short and stout setae.

Wings (Figs. 159, 160). Mummy brown, the two anteriormost veins and the first four or five branches of the cubitus darker ; all the veins distinct to the border ; margin and membrane densely ciliate, the membrane suffused with yellow behind the radial sector ; the cubitus of both wings with eight or nine branches ; membrane very densely covered with micrasters.

Legs.—Moderately long and stout.

Abdomen.—Moderately wide, bluntly rounded at the apex ; tergites clothed similarly to head ; ventral surface tawny olive, sternites 1–6 mummy brown laterally, the 6th also apically.

Measurements.	mm.
Length, with wings	9·50
,, without wings	5·50
Head, from base to apex of labrum, long	0·97
,, from base to clypeofrontal suture, long	0·68
,, at and including eyes, wide	0·95
Pronotum, long	0·40
,, wide	0·68
Wings, forewings, long	7·25
,, ,, wide	1·88
,, hindwings, long	7·00
,, ,, wide	2·00
Tibia iii, long	0·91
Abdomen, wide	1·14

Nymph.

Colour.—Creamy white ; wing buds fuscous ; total length 6 mm. ; antennae 13-jointed.

Soldier.

Colour.—Head hazel, a little lighter behind and in front, basal two-thirds of rostrum chestnut, apical one-third lighter ; antennae, pronotum and tergites of abdomen suffused with yellow ochre ; remainder of insect whitish.

Head (Fig. 28). Widest in the middle, broadly rounded behind, posterior half (without rostrum) hemispherical ; with a few pale setae ; rostrum slender, nearly half as long as remainder of head. Antennae mutilated ; the 1st joint half as wide as long, cylindrical ; 2nd two-thirds the length of 1st and nearly as wide ; 3rd a little longer than 2nd, narrow at base ; 4th as long as 2nd and wider than 3rd ; 5th to 9th increasing in length progressively ; 9th twice as long as wide.

Pronotum.—Of typical form, anterior half narrowed and bent up sharply; sides sloping abruptly to the rounded and slightly notched posterior margin; entire margin fringed with scanty reddish setae.

Legs.—Moderately long and slender; sparsely setaceous.

Abdomen.—Wide and bluntly rounded at apex; the tergites with scattered, moderately long setae.

Measurements.—	mm.
Total length	2·56
Head, from base to apex of rostrum, long	1·02
,, wide	0·62
Pronotum, long	0·11
,, wide	0·34
Tibia iii, long	0·39
Abdomen, wide	0·80

Worker.

Colour.—Dorsal surface of head and labrum burnt ochre, sides of head and frontal suture whitish; articulation of mandibles hazel.

Head.—Nearly as wide as long, widest across the middle; clypeofrontal suture only slightly concave; clypeus short, one-fifth as long as wide, not markedly convex, with scattered setae as on head; anteclypeus small, produced in the middle; labrum large, convex, rounded on the sides and in front. Antennae 12-jointed, the 1st joint long, cylindrical, one-third longer than 2nd; 2nd slightly narrowed at the base; 3rd narrowest of all, as long as 4th; 4th wider and more globose than 3rd; 5th to 11th increasing in length progressively: 12th as long as 10th, narrower than 11th.

Pronotum.—Small, saddle-shaped, half as wide as head, the margins with scanty setae as on head.

Legs.—Short, moderately stout, and setaceous.

Abdomen.—Short and wide, bluntly rounded at the apex: tergites and sternites moderately setaceous.

Measurements.—	mm.
Total length	3·00
Head, from base to apex of labrum, long	0·85
,, from base to clypeofrontal suture, long	0·62
,, wide	0·80
Pronotum, long	0·17
,, wide	0·40
Antennae, long	0·85
Tibia iii, long	0·40
Abdomen, wide	1·14

Locality.—New Ireland : Kaewieng (Dr. H. G. Wallace, 4.10.23).

Described from one alate imago, four nymphs, one soldier, and six workers.

Affinities.—The imago is very distinct from any hitherto described Australian species, and appears to have no very close ally in the Oriental fauna. The soldier resembles *E. gracilirostris* (Desn.) in the shape of the head, but the latter is distinguished by its larger size and differently coloured head.

Types (imago, soldier, and worker) in National Museum of Victoria.

Eutermes (?) vernoni Hill.

Proc. Linn. Soc., N.S.W., Vol. xlvii., 1922.

Two nest series of soldiers, workers, and nymphs from Papua are so closely related to the above species (from Townsville, N. Queensland) that it is considered advisable to withhold a description until imagos are available for comparison. The soldiers and workers are smaller than typical examples from Queensland. In the shape of the head and segmentation of the antennae there is no appreciable difference in either soldier or worker castes, but there are marked differences in the nature and disposition of the hairs on head and body. The termitaria also have some resemblance to each other, the slight differences observed being possibly due to local conditions.

Locality.—Papua : Fairfax Plantation (B. F. Hill) ; Yule Island (G.F.H., July, 1922).

Microcerotermes biroi (Desneux).

Ann. Mus. Nat. Hungarici., Vol. iii., 1905. Silvestri, Fauna Süd-west Australiens, 1909. Holmgren, Neu-Guinea Termiten, 1911.

Plate I., fig. 29 : Plate V., fig. 161 ; Plate VIII., fig. 162.

The following colonies appear to be referable to this species, the type locality of which is German New Guinea : (1) Imagos (Fig. 29) and two forms of workers from Fairfax Plantation, near Port Moresby, Papua (B. F. Hill, 1920), from a woody termitarium on tree-trunk near ground. (2) Several nest series of soldiers and workers (two forms) from blackish, woody termitaria on trunks of coconut palms, Ethel River (Mekeo District) and Kaile (30 miles south-east from Moresby), Papua (G.F.H., July, 1922). (3) Imagos (Figs. 161 and 162), one soldier and many workers, from termitarium on tree-trunk, Collingwood Bay, Papua (Dr. G. H. Vernon, 1921). The imagos in (1) and (3) agree with each other in all details : imagos and workers from the latter colony have been examined by Professor Holmgren, who considers them to be correctly referred

to this species. There are no imagos in (2) for comparison with those in (1) and (3). The soldiers in (1) and (2) agree with each other and with the description of *M. biroi*, excepting that the 3rd joint of the antennae in nearly all cases is markedly shorter, and nearly always markedly narrower than the 4th and 5th. (In the description of *M. biroi* this joint is said to be "generally a little longer and broader than the 2nd, or subequal to it . . . . . In a few cases the antennae are apparently of fourteen segments, the 3rd being more or less perfectly divided into two segments, of which the basal one is small, and shorter than the 2nd." Of the writer's specimens only a few individuals in a large colony from Kaile can be so described). The soldier found in (3) agrees in all details with the typical form. The workers of all three series have the 3rd segment shorter and narrower than the 2nd, and thus agree with some of the specimens described by Desneux; in other respects they are typical. (4) Two colonies of soldiers and workers from Daru, Papua (W. W. Froggatt).

Measurements of imagos from colony (1)—

	mm.
Length with wings	5·50–6·50
Head, from base to apex of labrum, long ..	1·14–1·19
,, from base to clypeofrontal suture, long ..	0·91
,, wide	0·93–0·96
Pronotum, long	0·39–0·47
,, wide	0·74–0·85
Wings, forewings, long	6·75–7·75
,, ,, wide	1·99–2·00
,, hindwings, long	6·25–7·50
,, ,, wide	1·93–2·16
Eyes, diameter, generally 0·255 x 0·255, rarely 0·289 x 0·289.	

Measurements of soldiers from Ethel River and Kaile, Papua.—

	mm.
Total length	5·25–6·50
Head, with mandibles, long	2·62–2·90
,, from base to clypeofrontal suture, long ..	1·70
,, wide	1·08–1·19
Pronotum, long	0·30–0·39
,, wide	0·68–0·74
Tibia iii, long	0·85

Measurements of workers from Ethel River and Kaile, Papua.—

	mm. Large form.	mm. Small form.
Total length	4·85–5·15 ..	4·00–4·27
Head, long	1·32 ..	1·00
,, wide	1·08 ..	0·90

Mr. Froggatt's collection contains a very closely allied species, represented by a nest series of imagos, nymphs, and workers collected by him at Kikori, Papua. The imago differs from *M. biroi* as identified by the writer in having larger eyes (0·323 x 0·323); larger ocelli (length 0·102, as against 0·085); ocelli near to the eyes, i.e., less than their short diameter; antennae lighter coloured: wings somewhat lighter (more greyish), with different micrasters. Desneux's description would apply equally well to this species, but until specimens have been compared with the types the species of which all castes are available for study is here regarded as the described form.

MICROCEROTERMES BIROI, sub-sp. *brevior* (Desneux).

Ann. Mus. Nat. Hungarici. Vol. iii, 1905. Holmgren. Neu-Guinea Termiten, 1911.

Locality.—German New Guinea.

MICROCEROTERMES PAPUANUS Holmgren.

Neu-Guinea Termiten, 1911.

Locality.—German New Guinea.

MICROCEROTERMES UMBRITARSUS, n. sp.

Plate I., figs. 30–33; Plate V., fig. 163; Plate VIII., fig. 164.

IMAGO.

Colour.—Head very dark brown, postclypeus rather lighter, anteclypeus cream colour; labrum yellow ochre; thorax and abdomen lighter than head, but darker than postclypeus; pleura, tarsi, antennae, and palpi mummy brown; sternites of abdomen mummy brown, darkest laterally; 6th visible sternite of male long and very dark; wings dark brown, lighter than in *M. biroi*.

Head (Fig. 30).—Densely setaceous, hairs of large and small size, postclypeus straight in front, convex behind, one-third as long as wide; anteclypeus nearly as long as postclypeus, rounded in front. Eyes comparatively large (0·289 diam.), very prominent, separated from the lower margin of head by a space equal to one-third the diameter. Ocelli small, broadly oval, well separated from the eyes. Fontanelle indistinct. Antennae (Fig. 31) 14-jointed; the 3rd joint very short and narrow, almost hyaline; 4th to 8th moniliform, increasing in size progressively.

Thorax (Fig. 30).—Pronotum nearly straight in front, antero-lateral angles rounded, sides sloping to the slightly sinuate posterior margin; the whole surface moderately densely haired. Meso- and metanotum with posterior margin deeply emarginate.

Wings (Figs. 163, 164).—Stumps of forewings a little larger than those of hindwings, densely setaceous, sutures straight. Radius and radial sector dark and setaceous to the extremity; the first seven or eight branches of the cubitus very dark, all veins distinct to the wing-border; membrane covered densely with minute micrasters.

Legs.—Moderately long and stout; tibiae much darker than femora; claws and tibial spurs very long and slender.

Abdomen.—Nearly cylindrical, bluntly rounded at the apex, moderately setaceous. Cerci short and very broad.

Measurements.—	mm.	mm.
Length with wings	♂ 10·00 ♀	11·00
,, without wings	♂ 5·40 ♀	5·88
Head, from base to apex of labrum, long ..	..	1·19
,, from base to clypeofrontal suture, long	..	0·68
,, wide	..	1·00
Pronotum, long	..	0·40
,, wide	..	0·74
Wings, forewings, long	..	8·25
,, ,, wide	..	2·10
,, hindwings, long	..	7·75
,, ,, wide	..	2·20
Tibia iii, long	..	1·50

Soldier.

Colour.—Head Sanford's brown (ochraceous tawny in young specimens), darkest in front; anteclypeus hyaline; labrum orange rufous; thorax and abdomen clay colour, legs slightly paler.

Head (Fig. 32).—Long and narrow, nearly twice as long as mandibles, widest at posterior fourth, slightly narrowed to the base of the mandibles, with a few long and short setae. Antennae (Fig. 33) 13-jointed; the 2nd joint long and narrow, distinctly longer than 3rd; 3rd shortest of all, as wide as 2nd; 4th and 5th equal, markedly longer than 3rd, globose. Gula at narrowest part one-fifth as wide as head.

Thorax. Pronotum a little more than half as wide as head, the anterior margin bent up and slightly emarginate in the middle; anterolateral angles rounded; posterior margin broadly truncate. Mesonotum half as wide as head, posterior margin similar to that of pronotum. Metanotum a little wider than mesonotum, the posterior margin broadly rounded.

Measurements.—	mm.
Total length	5·00–5·50
Head. with mandibles, long	2·40–2·67
,, without mandibles, long	1·65–1·70
,, to apex of labrum. long	1·88–1·99
,, wide	1·08–1·14
,, deep	0·85–0·90
Antennae, long	1·50
Pronotum. long	0·34
,, wide	0·62
Tibia iii. long	0·68–0·74

Worker.

Colour.—Generally yellow ochre to ferruginous in the larger form : postclypeus same colour. or a little lighter ; frons whitish. In the smaller form the head is generally chestnut brown, with pale head sutures and clypeus of the same colour as the remainder of head. In both forms the labrum is clay colour and the articulation of the mandibles reddish brown.

Head.—Broadly rounded behind. nearly parallel on the sides to the base of the mandibles. Clypeus markedly convex. divided axially by a distinct suture. the lobes very prominent. Antennae 13-jointed ; the basal joints segmented as in the imago.

Measurements.—	mm. Large form.	mm. Small form.
Total length	4·40 ..	3·40
Head, long	1·19 ..	0·85
,, wide	0·97 ..	0·74
Pronotum. wide	0·57 ..	0·51
Tibia iii, long	0·57 ..	

Locality.—New Britain : Beining District (G.F.H.. 10.6.22).

Described from a series of imagos. soldiers. and workers from a flattened. black. woody termitarium. 8 inches high. 17 inches long. and 12 inches wide. constructed on the ground in dense jungle on hill-side. About one-half the nest was buried in loamy soil and leaf-mould from which it was easily removed intact.

Affinities.—This species is closely allied to *M. froggatti*. n. sp. and *M. biroi*. From the former it is distinguished by the characters referred to in the discussion following the description of the new species ; from the later the imago is distinguised by its differently shaped thorax (cf. Figs. 29 and 30). larger and lighter coloured wings, more hairy head and darker antennae and palpi. The soldiers are very difficult to separate from those of *M. biroi*. which are generally a little smaller and have the sides of head more nearly

parallel. *M. novae-caledoniae* Holmgr. (from New Caledonia), the imago of which is undescribed, has not been examined, but the measurements of the soldier indicate a very distinct species. The following nest series are referred to this species provisionally :

(1) Queen, soldiers, and two forms of workers, from blackish, woody termitarium 4 feet long by 12 inches wide, on trunk of coconut palm, 6 feet from ground (New Britain, Beining District, G.F.H., 12.6.22). The queen, which agrees with the type, measures 27 mm. in length by 7 mm. across the abdomen. The soldiers differ from those in the type colony in their larger size, more rugose frons, and generally differently segmented antennae. The latter, in nearly all cases, have the 3rd joint longer and wider than 2nd, and the 4th and 5th joints more elongate. The 3rd joint is very rarely smaller than the 2nd, and then not markedly so. In the worker caste the 3rd joint is variable, being either distinctly smaller or larger than the 2nd, and the head is darker, i.e., Dresden brown in the larger form and mummy brown in the smaller, as is the case in the following series :

Measurements of soldiers.	mm.
Head, with mandibles, long	2·80–2·85
,, wide	1·14
Mandibles, long	0·91

(2) Queen, soldiers, and two forms of workers from a termitarium similar to (1), but smaller, situated 3 feet from the ground on trunk of coconut palm. New Britain, Neinduk (G.F.H., 14.6.22). The queen agrees with the type and also with the queen in (1), except in the size of the abdomen, which measures 15·00 mm. in length by 3·00 mm. in width. The soldiers are lighter coloured and smaller than those in (1), and differ from the type series in some of the measurements ; they agree with the latter in always having the 3rd antennal joint shorter than the 2nd. Workers as in (1).

Measurements of soldiers.	mm.
Head, with mandibles, long	2·50
,, wide	0·96–1·02
Mandibles, long	0·91
Pronotum, long	0·34
,, wide	0·62

(3) Soldiers and workers from a termitarium similarly situated to (2). New Britain, Toma (G.F.H., 8.6.22).

(4) Imago, from spider's web in bungalow. New Britain, Toma (G.F.H., 8.6.22).

(5) Soldiers and workers. New Britain, Rabaul (Dr. G. M. Heydon, December, 1923).

(6) One brachypterous queen, soldiers, workers (two forms), and many larvae and nymphs; from termitarium similar to (1). New Britain, near Rabaul (G.F.H., 6.6.22). The queen measures 4·85 mm. in length by 1·42 mm. in width: head mummy brown shading to Dresden brown posteriorly; pronotum, wing-pads, and tergites of abdomen Dresden brown; frontal and transverse sutures very distinct; eyes hyaline; ocelli as in imago, antennae 14-jointed, the 3rd joint very short.

Types (imago, soldier, and worker) in National Museum of Victoria.

Microcerotermes repugnans, n. sp.

Plate I., figs. 34–36.

Soldier.

Colour.—Head Sanford's brown, darkest anteriorly; anteclypeus hyaline; labrum orange yellow; mandibles dark reddish brown, nearly black; remainder of insect cream colour.

Head (Fig. 34).—Long, slightly rounded on the sides, rounded behind; with scanty, moderately large reddish setae, most numerous on postclypeus. Mandibles (Fig. 35) comparatively short and stout, finely serrated excepting towards the base, where there is a prominent tooth on each mandible. Anteclypeus short, anterior margin produced in the middle. Labrum large, broad, with several large setae towards the apex. Antennae (Fig. 36) short and stout, 13-jointed; the 3rd joint distinctly the shortest and narrowest; 4th and 5th equal, moniliform.

Thorax.—Pronotum narrow, anterior margin raised, rounded in front, not emarginate; anterolateral angles rather prominent; posterior margin broadly rounded, without emargination; with scanty, moderately long and stout hairs, each side with a long hair near the anterolateral angle. Mesonotum a little narrower than the pronotum, the porterior margin less rounded and having a scanty fringe of moderately stout hairs.

Legs.—Short and stout, with scanty, pale setae.

Measurements.—	mm.
Total length	4·00
Head, with mandibles, long	1·71
,, wide	0·85
,, deep	0·62
Mandibles, long	0·60
Antennae, long	0·91
Pronotum, long	0·28
,, wide	0·45
Tibia iii, long	0·57

WORKER.

Colour.—Head buff yellow, with a dark reddish spot at the articulation of the mandibles ; remainder whitish.

Head.—Almost hemispherical, flattened behind the clypeus. Postclypeus large, convex, straight in front, convex behind, divided axially by a distinct suture. Anteclypeus long, similar in shape to that of soldier. Labrum large, convex, widest in the middle, rounded in front. Antennae short and stout, 13-jointed, the 3rd joint shortest and narrowest.

Pronotum.—As in soldier, but with paler and finer setae.

Legs.—As in soldier.

Abdomen.—Long and slender, with scanty, pale coloured, short setae.

Measurements.—	mm.
Total length	3·64
Head, to apex of labrum, long	0·97
,, to clypeofrontal suture, long . .	0·68
,, wide	0·85
Pronotum, long	0·17
,, wide	0·40
Tibia iii, long	0·51

Locality.—Papua : 30 miles south-east from Port Moresby (G.F.H., 22.7.22).

Described from numerous soldiers and workers taken in a rotten log with *Calotermes* (*Cryptotermes*) *gulosus*, n. sp.

Affinities.—This species is very distinct from any other hitherto described from the Australian or Oriental Regions.

Types (imago, soldier and worker) in the National Museum of Victoria.

MICROCEROTERMES FROGGATTI, n. sp.

Plate V., fig. 165 ; Plate VIII., fig. 166.

IMAGO.

Differs from *M. umbritarsus*, n. sp. in its smaller size and in having the head and body a shade lighter in colour (more reddish) ; eyes and ocelli smaller, the latter more distant from the former ; pronotum very similar, but the posterior margin truncate ; meso- and metanotum more hairy and the posterior margin less deeply emarginate ; wings smaller, slightly paler in colour and with different micrasters (cf. Figs. 163 and 164 with Figs. 165 and 166).

Measurements.—

	mm.
Length with wings (♂)	8·00–8·50
,, without wings (♂)	5·40–5·60
Head, from base to apex of labrum, long ..	0·97
,, from base to clypeofrontal suture, long ..	0·68
,, wide	0·91
Eyes, diameter	0·238
Antennae, 14-jointed	..
Pronotum, long	0·40
,, wide	0·69
Wings, forewings, long	6·55
,, ,, wide	1·88
,, hindwings, long	6·38
,, ,, wide	1·88
Tibia iii, long	0·91
Abdomen, wide	0·96

QUEEN.

Total length, 24·00 mm.; abdomen, wide, 6·50 mm.

SOLDIER.

Generally as in *M. umbritarsus*, n. sp., but the head sometimes more nearly parallel on the sides.

Measurements.—

	mm.
Total length	5·00–5·50
Head, with mandibles, long	2·50–2·85
,, without mandibles, long	1·65–1·71
,, wide	0·97–1·11
Mandibles, from external articulation, long ..	0·91–1·08
Gula, at narrowest part, one-fifth as wide as head.	
Pronotum, long	0·29–0·34
,, wide	0·57–0·62

WORKER.

Colour. Large form: Head generally ochraceous orange, clypeus somewhat paler. Small form: Head chestnut brown, with pale sutures; postclypeus distinctly lighter than remainder of head.

There are intermediate forms as regards colour and size; otherwise similar to the workers of *M. umbritarsus*.

Measurements.—

	mm.
Total length	4·00–5·00
Head, from base to apex of labrum, long ..	1·25
,, from base to clypeofrontal suture, long ..	0·68
,, wide	0·97–1·08
Antennae, 13-jointed	..
Pronotum, long	0·28
,, wide	0·57–0·62
Tibia iii, long	0·62
Abdomen, wide	0·96

Locality.—Solomon Islands: Pepisala (type locality) and Banaka.

Described from a complete nest series collected by Mr. W. W Froggatt from a termitarium constructed on the trunk of a coconut palm. Three colonies from similar nests and one colony from a nest built on the ground were also examined.

Affinities.—As indicated above, the most closely related species appear to be *M. umbritarsus* and *M. biroi* (see notes on the former).

Types (imago, soldier and worker) in the National Museum of Victoria.

Capritermes schultzei Holmgren.

Neu-Guinea Termiten, 1911.

Locality.—German New Guinea.

Mirotermes odontomachus (Desneux).

Ann. Mus. Nat. Hungarici, Vol. iii, 1905. Holmgren, Neu-Guinea Termiten, 1911.

Locality.—German New Guinea.

C.—A REVISION OF THE AUSTRALIAN LEUCOTERMES, MICROCEROTERMES AND MIROTERMES.

Genus Leucotermes Silvestri.

List of known species, including those described in this paper :—

Species.	Locality.	Described Castes.		
		Imago.	Soldier.	Worker.
Leucotermes ferox (Frogg.) ..	New South Wales, Victoria, and South Australia ..	×†	×†	×†
,, *paradoxus* (Frogg.)	Queensland	×†	×†	×†
,, *clarki* Hill ..	South-west Australia ..	×*	×†	×*
,, *validus* (Hill) ..	Northern Territory ..	×†	×†	×†
,, *occiduus*, n. sp...	South-west Australia ..	×*	×*	×*
,, *vagus*, n. sp. ..	Northern Territory ..	..	×*	×*
,, *venustus*, n. sp...	Northern Territory ..	×*	×*	×*
,, *barretti*, n. sp. ..	Queensland	×*	×*	×*
? *Heterotermes platycephalus* Frogg.	South Australia	×	..	..

* Described in this paper. † Type or co-types examined.

LEUCOTERMES FEROX (Froggatt).

Proc. Linn. Soc. N.S.W., Vol. xxii., 1897. Froggatt, Dept. Agric., N.S.W., Bull. No. 60, 1915. Silvestri, Fauna Südwest Australiens, 1909. Mjöberg, Arkiv. för Zoologi, Vol. xii., No. 15, 1920. Hill, Bull. Ent. Res., Vol. xii., No. 4, 1922.

Plate V., fig. 167; Plate VIII., fig. 168.

It is doubtful if this species is as widely distributed as is recorded, and until imagos are available for confirmation South-west and North-west Australian records should be regarded as provisional only. Michaelsen and Hartmeyer's specimens from Serpentine, Western Australia, some of which I have seen, are undoubtedly referable to *L. occiduus*, while others from the same collection referred to *L. ferox* by Silvestri are doubtless *L. clarki*. Of 38 nest series collected by Mr. J. Clark in South-west Australia 36 are referred to either *L. clarki* or *L. occiduus*; the remaining two series, represented by soldiers and workers only, appear to differ specifically from all described species. Mjöberg's specimens (soldiers) from Cedar Creek, North Queensland, do not agree with Froggatt's type, nor with any other described species.

The imagos of *L. ferox* have 16-jointed antennae (40 specimens examined); the 3rd joint is generally the smallest of all, but it is commonly larger than the 4th. The soldiers generally have antennae of 15 joints; 16-jointed antennae are rare (this number occurs in a co-type).

Locality.—New South Wales: Broken Hill (F. Shepherd); Victoria: Lakes Entrance and Mallee District (F. E. Wilson), Seaford (W. F. Hill); South Australia (Tepper, from South Australian Museum collection).

Affinities.—This species is closely allied to *L. occiduus* and *L. barretti* (q.v.).

Biology.—Most of the colonies examined by me were collected under stones or logs or in the walls of nests of *Coptotermes*; but in one instance (Seaford, 4.10.20) a community comprising all castes, including numerous alate imagos, was found in association with *Calotermes* (*G.*) *rufinotum* Hill (= *obscurus* Hill nec Walker) in a soft-wood verandah-post the interior of which was considerably damaged by termites.

LEUCOTERMES PARADOXUS (Froggatt).

Proc. Linn. Soc. N.S.W., Vol. xxii., 1897. Hill, Bull. Entom. Res., Vol. xii., Pt. 4, 1922.

Plate II., figs. 37–40; Plate V., fig. 169; Plate VIII., fig. 170.

A more detailed description of this species is necessary to distinguish it from others added to the list since the publication of

Froggatt's monograph. The measurements given below include those of co-types (from the South Australian Museum collection) and numerous specimens from various colonies compared with them. Snyder (1924) has recorded the fact that ocelli are variably present or absent in American species of *Leucotermes* from the same colony; this applies also to the species under notice.

Imago. (Redescribed.)

Colour.—Head and body as in *L. clarki*; wings paler (tawny olive).

Head (Fig. 37).—Long and narrow, rather densely clothed with moderately long golden setae, longest and most numerous behind and below the eyes. Ocelli generally present (90 per cent. in a series of 64 specimens), small and well separated from the eyes. Eyes small, sub-triangular (0.204 x 0.221) or round (0.221 x 0.221), not prominent. Postclypeus markedly convex, divided axially by a distinct suture, with about 12 setae, the two median ones on the anterior margin markedly the longest; anteclypeus hyaline, about half as long as wide, truncate in front. Labrum yellow, small, markedly convex, widest at the basal third, with scattered setae, those about the middle longest. Fontanelle small, circular, very distinct. Antennae 18-, rarely 17-jointed: the 1st long and stout, widest at the apex; 2nd about half as long as the 1st, slightly wider at apex than at base; 3rd nearly always markedly the shortest and narrowest, but sometimes larger than 4th; 4th generally smaller than 5th, but sometimes larger; 5th generally a little smaller than 6th, but often equal; 6th to 16th or 17th moniliform, increasing in length progressively and becoming more stalked; 18th as long as 17th and very little narrower. Variations other than those noted occur.

Thorax.—Pronotum clothed similarly to head, large, narrower than head; anterior margin rounded, with a deep and wide emargination, antero-lateral angles broadly rounded, sides sloping to the sinuate posterior margin. Meso- and metanotum with posterior margin generally as in pronotum, but sometimes less sinuate, or almost truncate.

Wings.—Wing-stumps moderately densely clothed with long golden hairs; suture convex. Wings (Figs. 169, 170) long and narrow, the margin, excepting the proximal two-fifths of hind border, moderately densely ciliate; the radical sector, base of median and the proximal branches of cubital veins yellowish, the radial sector widely separated from the radius, the median branching from it beyond the suture in the hindwing, bending down sharply and passing through the anterior third of the wing, with three or four inferior branches beyond the distal fourth of the wing: the

cubitus with ten or eleven branches (some of which are forked), the most distal of which join the posterior margin near the apex of the wing. The membrane densely covered with micrasters and bearing scattered minute setae.

Legs.—Short and moderately stout; femora with very few hairs, these mostly near the apex; remainder of legs clothed similarly to pronotum; apical spurs long and slender; claws long and slender.

Abdomen.—Long and narrow, clothed similarly to pronotum; cerci large, basal segment as long as apical and very broad; styli long and slender.

Measurements.—	Co-type mm.	N.Q. specimens. mm.
Length with wings	10·00	9·50–10·00
,, without wings	5·00	4·50– 5·00
Head, from base to apex of labrum, long	1·00	1·14
,, from base to clypeofrontal suture, long	0·85	0·80–0·85
,, wide	0·85	0·85
Antennae, long	1·70	1·70
Pronotum, long	0·51	0·51–0·57
,, wide	0·74	0·68–0·74
Wings, forewings, long	8·00	7·80
,, ,, wide	2·00	1·76
,, hindwings, long	..	7·50
,, ,, ,,	..	1·82
Tibia iii, long	0·85	0·85

Soldier.

Colour.—Head orange rufous; pronotum and legs yellow ochre: mandibles dark ferruginous; remainder of insect cream colour.

Head (Figs. 38, 39).—With a few long pale hairs; long and narrow, nearly parallel on the sides to the antennal fossae; nearly straight on top (viewed in profile), the anterodorsal prominences very little elevated. Clypeus moderately large, half as long as wide, truncate in front, a dark ferruginous spot at each end. Labrum long, conical, pointed at the apex, where there are two long and several short setae. Gula long and narrow, about three-sixteenths as wide as head at its narrowest part. Mandibles of typical form. Antennae 17-, or rarely, 18-jointed; the 3rd joint nearly always smallest of all, but sometimes larger than 4th; 4th generally smaller than 5th, but sometimes larger; 5th and 6th equal or nearly equal; the remaining joints moniliform and increasing in length progressively but very slightly; the last about as long as the penultimate and very little narrower; other variations than those mentioned often occur.

Thorax (Fig. 40).—Pronotum similar to, but somewhat shorter than, that of imago, with very scanty setae, the two impressions behind the anterior margin very distinct. Meso- and metanotum generally with the posterior margin very slightly sinuate, but very variable.

Legs.—Short, femora very stout; the latter almost hairless; only scanty hairs on tibiae. Tibial spurs and the claws long and slender.

Abdomen.—Short and narrow, with scanty, small, pale setae, mostly at the apex of the segments.

Measurements.—	Co.-type. mm.	N.Q. Specimens. mm.
Total length	5·00	.. 5·00
Head, with mandibles, long ..	2·39–2·59	.. 2·50–2·60
,, without mandibles, long	1·42–1·45	.. 1·48–1·60
,, wide	0·91–0·98	.. 0·96
,, deep	0·74–0·79	.. 0·79
Mandibles, from external articulation, long	1·02	.. 1·08–1·14
Gula, at narrowest part, wide ..	0·17	.. 0·17
Pronotum, long	0·51	.. 0·57
,, wide	0·66–0·68	.. 0·74
Antennae, long	..	.. 1·65
Tibia iii, long	0·70	.. 0·79

WORKER.

Colour.—Head chamois, frons whitish, remainder of insect cream colour.

Head.—With scanty, pale setae, as on thorax: large, widest behind the antennal fossae. Clypeus moderately large, convex, truncate in front, rather less than half as long as wide, with a pale ferruginous spot at each end: anteclypeus large, about one-quarter as long as wide, truncate in front. Labrum large, convex, narrow at the base, widest at the posterior third, bluntly pointed in front. Antennae 17-, rarely 18-jointed, the 3rd joint shortest, generally coalesced with 4th.

Thorax.—Pronotum similar to that of soldier.

Abdomen.—Long and narrow, with very few setae, these small and mostly on the apical margin of tergites.

Legs.—Short and moderately stout, femora very stout, with few setae.

Localities.—Queensland: Mackay (type locality); Brisbane (H. Hacker, 13.9.12, all castes); Rollingstone (G.F.H., 21.2.20, all castes); Torrens Creek (G. F. Cook, Feb., 1922, all castes); Prairie

(J. R. Chisholm, soldiers and workers); Gordonvale (F. H. Taylor); Townsville (G.F.H., all castes); ? Banks Island, Torres Strait (G. A. Luscombe, imagos).

Biology.—The soldiers in two colonies (without imagos) from coastal sand-dunes near Townsville have antennae of 16, 17 or 18 joints, and are generally smaller than the co-types or any other series that can, by their associated imagos, be definitely referred to this species. Both colonies were found on the stems of dead herbaceous plants which had been destroyed under cover of a protective sheathing formed of particles of sand cemented together. The Banks Island specimens (four imagos, with ocelli) differ from others in having slightly larger eyes and 17-jointed antennae, the latter with the 3rd joint shortest of all and the 4th larger than 5th. The colonies from Rollingstone and Torrens Creek were found in the interior of small standing stumps and under the clayey protective sheathing built around them by the termites. Other colonies, comprising soldiers and workers only, were found in the vicinity of Townsville under logs or stones and in the abandoned nests of *Hamitermes wilsoni* Hill. Numerous imagos were captured on the wing in the same locality at dusk on 27th February after a heavy fall of rain, and on numerous occasions between 7th October and 27th February at lights in-doors. Mr. Taylor's specimens from Gordonvale include soldiers and workers found in sugar-canes. In the original description the soldier is said to have the "forehead projecting and hiding the clypeus": this is obviously an error (see Figs. 38 and 39).

Affinities.—The imago is very closely related to *L. validus* and were the soldiers not available for comparison one might now hesitate to regard the latter as more than a variety. The differences in the imago are constant, though slight, and this fact, taken into consideration with the more pronounced differences in the soldiers, appears to justify the retention of *L. validus* as a distinct species, differentiated in the imago by its larger size, longer wings, different wing micrasters, and stronger setae on thorax and abdomen. The soldier of *L. paradoxus* has a distinctly shorter and relatively wider head and gula, more numerous but smaller hairs on head, thorax and abdomen, slightly shorter and distinctly more slender mandibles, sides of pronotum more rounded, and posterior margin much more deeply notched.

Leucotermes clarki Hill.

Bull. Entom. Res., Vol. xxii, No. 4, 1922.

Plate V., fig. 171; Plate VIII., fig. 172.

Owing to an unfortunate error descriptions of the imago and worker of *Hamitermes obeuntis* Silv. were substituted in the above

paper for those of *L. clarki*. The following descriptions are from specimens from Mundaring, South-west Australia. All possibility of these specimens not being conspecific with the type (soldier) of *L. clarki*, from Swan River, South-west Australia, has been eliminated by a careful comparison of several nest series from both localities with each other and with the type.

Imago.

Colour. Head clay colour, suffused with brown on dorsal surface; antennae, clypeus and legs somewhat paler; thorax and abdomen clay colour to Dresden brown; wings buffy brown, costal margin distinctly paler (especially noticeable in specimens in alcohol).

Head. Small, about as long as wide, moderately hairy, flat between fontanelle and clypeus. Clypeus small, three-eights as long as wide, markedly convex, glabrous, divided by a distinct suture, the articulation of the mandibles forming a ferruginous spot at each end, posterior margin arcuate, the anterior margin slightly concave, two rows of four moderately stout setae, the anterior most of which is very near the margin. Anteclypeus very short, but as long as postclypeus, anterior margin truncate. Labrum very small, about one-fifth longer than clypeus, wide at base, narrowed sharply to the rounded apex, with a few setae on apical half. Antennae 18-, more often, 19-jointed; the 3rd generally smallest; 4th a little longer than 5th and 6th; very rarely the 3rd a little larger than 4th, and the 4th smallest of all; the remaining joints moniliform, the last five or six, excepting the apical one, more stalked than the preceding ones. Eyes small, subtriangular, vertical and horizontal diameter equal, i.e., 0·204–0·238, not prominent, widely separated (0·153–0·187) from the lower margin of the head. Ocelli small, broadly oval, very close to but not touching the eyes. Fontanelle small, circular, very distinct, in line with the posterior margin of the eyes.

Thorax. Pronotum of typical form, narrower than head, the anterior margin slightly raised, curved, with deep and narrow notch in the middle; anterolateral angles rounded; sides narrowed to the sinuate posterior margin; a deep impression behind the anterior margin on each side of the median line; the whole surface moderately setaceous, like head. Meso- and metanotum widely notched posteriorly, both more distinctly than the pronotum, the mesonotum more markedly than the metanotum.

Wings. Wing-stumps of the mesonotum larger than those of metanotum, not quite reaching the apex of the sclerite; those of the metanotum covering about two-thirds of its sclerite; the base of the veins very distinct. Wings (Figs. 171 and 172) long and slender; the radial sector darkest in colour, well separated from the

radius ; median distinct only at its base ; the cubitus with eight or nine branches, the first six distinct, the 5th, 6th, and 7th often branched once or twice. The membrane densely covered with microsters and with a few minute setae.

Legs.—Moderately stout, short and hairy ; tibial spurs long and slender.

Abdomen.—Long and narrow, widest about the middle, tapered to the bluntly-pointed apex. Cerci moderately long, wide at the base ; styli long and slender.

Measurements.—	mm.
Length with wings	13·25–14·00
,, without wings	5·50–6·00
Head, base to apex of labrum, long	1·08
,, base to fontanelle, long	0·57
,, base to clypeofrontal suture, long ..	0·91
,, wide	1·02
Pronotum, long	0·57
,, wide	0·85
Wings, forewings, long	12·00
,, ,, wide	2·62
,, hindwings, long	11·25
,, ,, wide	2·62
Tibia iii, long	0·91

Queen.

Total length, 15·00 mm. ; abdomen, wide, 5·00 mm.

Soldier.

An examination of a long series of soldiers (from four colonies), in which imagos are present and have been examined in verification of the identification, shows that in this species at any rate there is little variation in the size of individuals composing the colonies as indicated in the following :

	Range.	Average.
Head, with mandibles, long ..	2·96–3·19 ..	3·10
,, posterior margin to fontanelle, long	1·17–1·42 ..	1·31
,, without mandibles, long ..	1·93–1·99 ..	1·98
,, wide	1·14–1·22 ..	1·17
Pronotum, wide	0·88–1·02 ..	0·96

The antennae are composed of 16 to 18 joints ; 17 is the usual number present, but 16 joints occur frequently, while the larger number has been found in only one specimen.

Worker.

Colour.—Head pale orange yellow, frons whitish, a dark ferruginous spot at each end of clypeus; remainder of insect cream colour.

Head.—With scanty pale setae; nearly as wide as long, widest about the middle, posterior half almost hemispherical; frons flat; fontanelle small, but distinct; clypeus and labrum similar to imago. Antennae 17- or 18-jointed, segmentation of proximal joints variable, as in imago.

Thorax.—Pronotum similar to that of imago; the posterior margin of mesonotum and metanotum broadly rounded, with indistinct emargination in the middle.

Legs.—Short and moderately stout, with scanty, pale, short setae.

Abdomen.—Moderately slender, tapered to the bluntly-pointed apex; with pale, short setae, as on thorax. Cerci moderately large.

Measurements.—

	mm.
Total length	4·50–5·00
Head, base to apex of labrum, long	1·31
,, wide	1·14
,, deep	0·57
Pronotum, long	0·44
,, wide	0·82
Tibia iii, long	0·75–0·80

Localities.—South-west Australia: Swan River (type locality), Dwellingup, Ludlow, Mundaring, Albany, Denmark, Gosnells, Lion Mill, Boyanup (J. Clark).

Affinities.—The imago and soldier are distinguished from all other described Australian species by their larger size. The imago is distinguished from *L. ferox* and *L. occiduus* by its much paler colour and two or three additional antennal joints. The imago of *L. vagus* is unknown, but it is almost certain to be a very small form closely allied to *L. venustus*.

In addition to the above, Mr. Clark has collected several colonies of soldiers and workers at Lion Mill which appear to belong to an undescribed species. The soldiers in these colonies are intermediate in size between *L. clarki* and *L. ferox* and have antennae with 15 or 16 joints, very rarely with 17 joints. As none of the soldiers associated with the alate form of *L. clarki* are as small as these they may be regarded as indeterminable until more complete series are to hand.

Biology.—Mr. Clark's collections include specimens from 39 colonies, in four of which all the castes are represented. One of the latter colonies was found in a termitarium occupied by all castes of *Hamitermes obeuntis* Silv. ; the remaining three were not associated with other species. Thirty-five colonies were represented by soldiers and workers only, of which number 22 were associated with *Hamitermes obeuntis* Silv., 10 with *Eutermes occasus* Silv., 2 with *Eutermes apiocephalus* Silv., and 1 with *Calotermes obscurus* (Walker).

Types (imago, soldier and worker) in National Museum of Victoria.

Leucotermes validus (Hill).

Proc. Linn. Soc. N.S.W., Vol. xl, Pt. 1, 1915. Bull. Entom. Res., Vol. xii, No. 4, 1922.

Plate II., figs. 41–45 ; Plate V., fig. 173 ; Plate VIII., fig. 174.

Imago.

The imago was described as having 16-jointed antennae ; the number should have been given as 18, rarely 17. The segments vary in form as noted in *L. paradoxus*. Ocelli appear to be invariably absent. The following are additional measurements from numerous specimens collected near the type locality : —

Measurements. —	mm.
Length with wings	10·00–11·50
,, without wings	4·50– 5·50
Head, from base to apex of labrum, long	1·14– 1·19
,, from base to clypeofrontal suture, long	0·85– 0·91
,, wide	0·85
Pronotum, long	0·51
,, wide	0·74
Wings, forewings, long	9·50
,, ,, wide	2·00
,, hindwings, long	8·50
,, ,, wide	2·10
Eyes, diameter	0·221
Tibia iii, long	0·85

Soldier.

Head, with mandibles, long	2·90–3·20
,, without mandibles, long	1·90–2·05
,, wide	0·97–1·02
,, deep	0·85–0·97
Gula, at narrowest part, wide	0·17
Mandibles, from external articulation, long	1·14–1·25
Antennae, long	1·53
Pronotum, long	0·62
,, wide	0·85–0·91
Tibia iii, long	0·79–0·85

Locality.—Northern Territory: Darwin (type locality) and Koolpinyah.

Affinities.—The similarity between this species and *L. paradoxus* has been noted elsewhere in this paper.

Biology.—A large colony of these termites, including many alate imagos, was taken on 7th December near the type locality from the interior of a hardwood verandah-post.

Types (imago, soldier and worker) in National Museum of Victoria.

Leucotermes occiduus, n. sp.

Plate II., figs. 46–48; Plate V., fig. 175; Plate VIII., fig. 176.

Imago.

Colour.—Very dark brown; antennae, palpi and legs lighter; clypeus Sudan brown; anteclypeus hyaline; labrum brown, like antennae, apex hyaline; apical part of tibiae and tarsi cream colour; wings fuscous.

Head (Fig. 46).—Longer than wide, with scattered pale hairs. Fontanelle small, circular, prominent, in line with the posterior margin of the eyes. Eyes small, sub-triangular, 0·170 × 0·170, not projecting beyond the sides of the head. Postclypeus small, markedly convex, arcuate behind, slightly concave in front, with a distinct median suture and about twelve long setae; anteclypeus very short, hyaline, suffused with brown. Labrum narrow at the base, widening considerably at the basal third and narrowed sharply to the truncate apex. Antennae (Fig. 47) 15- or 16 jointed; the 3rd joint smallest; 4th larger than 5th, equal to 6th, or 3rd (rarely) larger than 4th, and 4th smallest of all.

Thorax.—Moderately setaceous, like head. Pronotum narrower than head, anterior margin elevated, rounded and widely emarginate in the middle, anterolateral angles rounded, the sides sloping to the emarginate posterior border, a deep impression on each side of the median line behind the raised anterior border. Posterior margin of the mesonotum more widely emarginate than the pronotum, the metanotum more so than the mesonotum.

Wings.—Wing stumps unequal, with setae as on pronotum; the base of the veins distinct. Wings (Figs. 175, 176) long and slender, the two anteriormost veins widely separated; the median distinct only at its base, with several branches beyond the middle to the apex and posterior border of the wing; cubitus short, with about ten branches in the forewing and about twelve in the hindwing. Membrane densely covered with micrasters and with scanty minute setae.

Legs.—Short and moderately slender, with few setae: tibial spurs and claws long and slender.

Abdomen.—Long and narrow, broadly rounded at the apex, clothed similarly to thorax. Cerci moderately long and stout: styli long and slender.

Measurements.—	*L. occiduus.*	*L. ferox.*
	mm.	mm.
Length with wings ..	11·00–11·50 ..	..
,, without wings ..	4·00 ..	4·50–5·00
Head, base to apex of labrum, long	0·91 ..	1·25
,, base to clypeofrontal suture, long ..	0·68 ..	0·74–0·79
,, base to fontanelle, long	0·37 ..	0·40
,, base to fontanelle, wide	0·73 ..	0·90
Antennae, long	2·05 ..	..
Pronotum, long	0·40–0·45 ..	0·47–0·50
,, wide	0·57–0·62 ..	0·68–0·70
Wings, forewings, long ..	8·50 ..	9·00
,, ,, wide ..	1·99 ..	2·28
,, hindwings, long ..	8·00 ..	..
,, ,, wide ..	2·05 ..	..
Eyes, diameter	0·17 ..	0·18

Soldier.

Colour.—Head antimony yellow; mandibles ferruginous: remainder of insect whitish.

Head.—Long and narrow, slightly wider across the middle than elsewhere, broadly rounded behind, with very few setae. Antennae (Fig. 48) 15- or 16-jointed (15 normally); the 3rd joint shortest: 4th larger than 5th, equal to 6th; or 3rd larger than 4th. Mandibles long and slender, of typical form. Labrum long, conical, one-third longer than wide.

Thorax.—Pronotum similar to that of imago. Posterior margin of mesonotum slightly sinuate, that of metanotum nearly straight.

Legs.—Short and moderately stout, with scanty setae.

Abdomen.—Long and slender, widest about the middle, with scanty pale, short setae. Cerci long and slender.

Measurements.—	*L. occiduus.*	*L. ferox* (co-type).
	mm.	mm.
Total length	4·50	5·00
Head, with mandibles, long	2·16	2·50
,, without mandibles, long ..	1·33	1·08
,, wide	0·74	0·91
,, deep	0.62	0.74
Mandibles, from external articulation, long	0·82	1·20
Antennae, long	1·24	..
Pronotum, long	0·45	0·51
,, wide	0·62	0·74
Tibia iii, long	0·62	0·74

Worker.

Colour.—Head cream, with a ferruginous spot at each end of clypeus; remainder whitish.

Head.—Slightly longer than wide, widest part in line with insertion of antennae, broadly rounded posteriorly, with scanty pale setae; sutures indistinct. Clypeus and labrum as in imago, the former markedly glabrous and convex. Antennae 15-jointed; the 3rd or 4th joint shortest.

Thorax.—Pronotum narrower than head, similar to that of soldier, with scanty fringe of pale setae. Meso- and metanotum as in soldier.

Legs.—Short and moderately stout, with few setae.

Abdomen.—Long and rather narrow, widest about the sixth tergite, with a scanty fringe of pale, short setae at the apex of each segment.

Measurements.—	mm.
Total length	3·40
Head, base to apex of labrum, long	1·08
,, base to clypeofrontal suture, long	0·68
,, wide	0·80
Pronotum, long	0·28
,, wide	0·51
Tibia iii, long	0·54

Localities.—South-west Australia: Mundaring (type locality), Wongong, Ludlow, Dwellingup, Gosnells, Chidlow's Well, Hovea, Armadale (J. Clark), Merredin (L. J. Newman).

Affinities.—This species is closely related to *L. ferox*, the measurements of imago and soldier of which are given for comparison. Apart from its smaller size the imago of the proposed new species differs

from *L. ferox* in having the head, body, femora and wings slightly darker; venter less hairy; ocelli slightly larger, more rounded and in contact with the eyes (in *L. ferox* the ocelli are very narrow and widely separated from the eyes). The soldiers also are smaller than in Froggatt's species.

Biology.—Of the 32 colonies collected by Mr. Clark, 28 were associated with other species, as follows:—12 with *Hamitermes sp.*, 6 with *Hamitermes obeuntis* Silv., 4 with *Eutermes apiocephalus* Silv., 3 with *Eutermes occasus* Silv., 1 with *Coptotermes sp.*, 2 with *Coptotermes sp.*, *Hamitermes obeuntis* and *Eutermes apiocephalus*, and 4 with *Hamitermes sp.* and *Mirotermes kraepelini* Silv. Alate imagos were found in March, April, and May. A brachypterous queen was found in one colony.

Types (imago, soldier and worker) in National Museum of Victoria.

Leucotermes vagus, n. sp.

Plate II., figs. 49–51.

Soldier.

Colour.—Head ochraceous tawny, palest anterodorsally; pronotum and legs somewhat lighter; mandibles uniform dark ferruginous.

Head (Fig. 49).—Long and narrow, widest across the middle; posterior margin broadly rounded, anterodorsal surface raised into two prominences, the front sloping rather sharply to the clypeus, which is moderately large and conspicuous; anteclypeus hyaline, nearly truncate in front. Labrum orange yellow, very long, acuminate, the apex hyaline and bearing two conspicuous long hairs. Fontanelle small but distinct. Mandibles long, curved inwards at the tip, with dentition as in *L. venustus* (Fig. 54). Antennae (Figs. 50, 51) 13- or 14-jointed; the 3rd smallest of all; 4th generally markedly larger than 5th. Dorsal surface of head clothed rather densely with short, fine setae, fewer and longer on the front.

Thorax.—Pronotum moderately setaceous, much narrower than head, markedly emarginate in front, with a deep impression on each side about the anterior third, anterolateral angles broadly rounded, sides curving in to the rounded posterior margin, which is rather deeply notched in the middle. Meso- and metanotum broadly rounded posteriorly, the former faintly sinuate in the middle.

Legs.—Short and stout; femora markedly so.

Abdomen.—Slender; clothed rather densely with pale setae; cerci short and moderately stout; styli long and slender.

Measurements.—	mm.
Total length	3·50
Head, with mandibles, long	2·00
,, posterior margin to fontanelle, long	0·86
,, wide	0·75–0·85
,, deep	0·62
Mandibles, entire length	0·91
Antennae, long	1·25
Pronotum, long	0·35
,, wide	0·52
Tibia iii, long	0·57

Worker.

Colour.—Head somewhat paler than that of soldier; remainder of insect cream buff.

Head.—Moderately setaceous, very broad, almost parallel on the sides and markedly rounded behind. Clypeus small, convex, glabrous. Labrum markedly convex and broad, rounded in front. Antennae 13-jointed; the 2nd joint quadrate; the 3rd always shortest and narrowest; the remaining joints, excepting the last, moniliform.

Thorax.—Pronotum very much narrower than head, the anterior margin sinuate, but not deeply emarginate as in the soldier; antero-lateral angles somewhat less rounded than in soldier; sides and posterior margin as in the latter. Posterior margin of meso- and metanotum as in soldier.

Legs.—Short and stout; moderately setaceous.

Abdomen.—Clothed similarly to legs; cerci short and stout; styli long and slender.

Measurements.—	mm.
Total length	3·50
Head, from base to apex of labrum, long	0·97
,, from base to clypeofrontal suture, long	0·62
,, wide	0·74
Pronotum, long	0·27
,, wide	0·44
Tibia iii, long	0·47

Locality.—Northern Territory: Darwin.

Affinities.—This is the smallest described Australian species of *Leucotermes*, its nearest ally being *L. venustus*, from which it is easily distinguished by the shape of the labrum and fewer jointed antennae.

Biology.—The type colony, which was taken from an imported soft-wood box lying upon the ground (G.F.H., 1.8.14), comprised

many workers and a few soldiers and nymphs. The latter were in the stage preceding the final moult, the antennae then having 15 joints. Stained specimens showed no indication of the presence of ocelli. A second colony (soldiers and workers only) was taken in the near vicinity on 26.10.10 in similar circumstances. In both instances the exposed surfaces of the timber were encased in a thin brittle layer of earthy matter under cover of which considerable damage had been done.

Types (soldier and worker) in National Museum of Victoria.

Leucotermes venustus, n. sp.

Plate II., figs. 52–56; Plate V., fig. 177; Plate VIII., fig. 178.

Imago.

Colour.—Head and pronotum clay colour, remainder of upper surface tawny olive; legs and under surface cream buff; wings very pale buff, suffused with light brown behind the radial sector and between the first five branches of the cubitus.

Head (Fig. 52). Small, narrow, noticeably longer than wide, moderately setaceous. Eyes small, sub-triangular (0·170 vertically × 0·204 laterally), finely facetted, not prominent, widely separated from the lower margin of the head. Ocelli wanting. Fontanelle small, distinct, in line with the posterior margin of the eyes. Postclypeus cream buff, short, one-fourth as long as wide, arcuate behind, straight in front, with a distinct median suture. Anteclypeus hyaline, small, truncate in front. Labrum long and narrow, widest behind the middle, then sloping to the bluntly-pointed apex, with a few short, pale setae on the apical half. Antennae (Fig. 53) 16- or 17-jointed; the 1st joint short and wide; the 2nd half as long, quadrate; 3rd narrower and shorter than 2nd, very little narrowed at base; 4th globose, a little shorter and narrower than 5th, smallest of all; 5th, 6th and following joints to the 15th or 16th increasing in length progressively but all relatively short and wide; the last joint as long as the penultimate, but narrower; or, rarely, 3rd markedly the shortest and narrowest, the 4th a little longer than 5th, but smaller than 6th.

Thorax.—Pronotum moderately setaceous, very little arched, lateral and posterior margins produced, with a deep impression on each side of the median line about the anterior third, narrower than the head, about one-third wider than long; anterior margin sinuate, deeply emarginate in the middle; anterolateral angles broadly rounded; sides sloping slightly to the broadly rounded posterior margin, the middle of which is less emarginate than the anterior margin. Posterior border of meso- and metanotum broadly truncate, with indistinct emargination in the former.

Wings.—Wing-stumps of the forewings large, about one-third larger than those of the hindwings; setae as on pronotum. Wings (Figs. 177, 178) long and narrow; the radial sector, the base of the median and cubital veins and the first three or four branches of the latter very distinct; the radial sector widely separated from the radius; the median, excepting at the base, and the distal branches of the cubitus very indistinct. Wing-membrane densely covered with micrasters.

Legs.—Short and stout, moderately setaceous, the femora very stout; tibial spurs long and slender.

Abdomen.—Long and narrow, narrowest at the base, widening gradually to the fifth tergite, then narrowed to the broadly-rounded apex; the whole surface covered with pale setae. Styli long and slender.

Measurements.—	mm.
Length with wings	9·25
,, without wings	4·50
Head, from base to apex of labrum, long	0·97
,, from base to clypeofrontal suture, long	0·74
,, from posterior margin to fontanelle, long	0·45
,, wide	0·74
,, deep	0·45
Pronotum, long	0·42
,, wide	0·62
Wings, forewings, long	7·80
,, ,, wide	1·70
,, hindwings, long	7·50
,, ,, wide	1·75
Tibia iii, long	0·68
Abdomen, wide	0·62

Soldier.

Colour.—Head yellow ochre; mandibles ferruginous at the base, darker towards the tip; remainder of insect cream buff.

Head.—Long and narrow, with scattered pale setae; nearly parallel on the sides. Labrum (Fig. 54) long and narrow, bluntly pointed at the apex, covering one-third of mandibles. Mandibles long and slender, curved inwards at the tip, the left with three serrations and a large blunt tooth near the base, the latter opposed to a pit in the right mandible. Antennae (Fig. 56) 16-jointed; the 2nd short, nearly quadrate; 3rd smaller than 2nd, but larger than 4th; 4th smallest of all; 5th onwards to 15th increasing in length progressively, but all short and broad.

Thorax.—Pronotum similar in shape to that of imago, but with fewer setae and anterior and posterior margin more deeply emarginate. Meso- and metanotum with posterior margin broadly rounded.

Legs.—Short and stout, moderately setaceous, femora markedly thickened.

Abdomen.—Long and slender, bluntly rounded at the apex, with scanty setae. Styli long and slender.

Measurements.—	mm.
Total length	3·50
Head, with mandibles, long	2·10–2·28
,, without mandibles, long	1·31
,, from posterior margin to fontanelle, long	0·85
,, wide	0·74
Mandibles, long	0·96
Pronotum, long	0·40
,, wide	0·57
Tibia iii, long	0·60

Worker.

Colour.—Head pale orange yellow; remainder of insect whitish.

Head.—Large, widest behind the articulation of the mandibles, narrowed slightly to the broadly-rounded posterior margin. Post-clypeus short, convex, truncate in front; anteclypeus very small, slightly produced in the middle. Labrum narrowed at the base, widest at the posterior third, rounded at the apex, a few long setae on the apical half. Antennae 15-jointed; the 3rd joint smallest of all.

Thorax.—Pronotum similar to that of imago, but with anterior third slightly raised; with few setae. Meso- and metanotum with posterior border slightly sinuate; with very scanty pale setae, as on abdomen.

Legs.—Short and stout; with scanty, moderately long setae, as on abdomen.

Measurements.—	mm.
Total length	3·00
Head, from base to apex of labrum, long	1·02
,, wide	0·80
Pronotum, long	0·29
,, wide	0·51

Locality.—Northern Territory: Stapleton, 70 miles south from Darwin.

Affinities.—The imago is easily distinguished from other described forms by its small size, but it is probably very similar to the, as yet,

unknown imago of *L. ragus*. The distinguishing characters of the soldiers are referred to under the last-mentioned species. There are four alate imagos in National Museum collection (collected by Mr. J. A. Kershaw, Claudie River, North Queensland) which differ from *L. rennstus* apparently only in the size and density of the setae on head, thorax and abdomen.

Biology.—This species is known only from a colony captured on 4.11.14 (G.F.H.) in small underground passages in wet, black, peaty soil formerly covered with dense tropical jungle but at the time under cultivation as a banana plantation.

Types (imago, soldier and worker) in the National Museum of Victoria.

Leucotermes barretti, n. sp.

Imago.

Closely allied to *L. ferox* (Frogg.), from which species it differs in the following respects:—Pleural sclerites lighter; antennae, tarsi and femora darker; abdomen, especially the three terminal segments, lighter; sternites 1–5 and tergites 1–4 with apex pale (not uniformly dark); 8th sternite in male orange yellow: eyes much larger, more prominent and nearer to lower margin of head (i.e., 0·085, as against 0·141–0·170); ocelli larger (i.e., length 0·085, as against 0·068), but about the same distance from eyes; head narrower; fontanelle indistinct; wing-stumps of mesonotum shorter (i.e., 0·49, as against 0·59); pronotum with anterior margin nearly straight, without emargination (deeply notched in *L. ferox*); mesonotum with sides rounded and the posterior margin in the form of two rounded lobes; metanotum rounded on sides and behind, without emargination (in *L. ferox* the sides of the meso- and metanotum are nearly straight and slope to the posterior margin, which is broadly notched in the former and almost truncate in the latter). The antennae are mutilated: the five basal segments are like those of *L. ferox*.

Measurements.—

	mm.
Length without wings	5·00
Head, to apex of labrum, long	1·02
,, to clypeofrontal suture, long	0·60
,, wide	0·86
Eyes, diameter	0·255
Pronotum, long	0·42
,, wide	0·68
Tibia iii, long	0·91

(For measurements of *L. ferox* see under *L. occiduus*.)

Soldier.

Very like *L. ferox*, apparently differing only in having 17-jointed antennae. The 3rd joint of the antenna is shortest of all, as is generally, but not always, the case in Froggatt's species.

Measurements.—

	mm.
Total length	4·50
Head, to apex of mandibles, long	2·45
,, wide	0·85
Pronotum, long	0·51
,, wide	0·68

Worker.

Similar to *L. ferox*, but having 16-jointed antennae.

Measurements.—

	mm.
Head, base to apex of labrum, long	1·14
,, base to clypeofrontal suture, long	0·74
,, wide	0·91
Pronotum, long	0·34
,, wide	0·59
Tibia iii, long	0·61

Locality.—Queensland : Rockhampton.

Described from a small series comprising one deälated imago, one soldier, and several workers and first-form nymphs. Collected by Mr. Charles Barrett (19.10.24).

Types (imago, soldier and worker) presented to the National Museum of Victoria by the collector.

Heterotermes platycephalus Froggatt.

Proc. Linn. Soc. N.S.W., Vol. xxl, 1896. Desneux, Genera Insectorum, 1904. Holmgren, Kungl. sv. vet. Handl. Bd. 46, No. 6, 1911. Mjöberg, Arkiv. för Zoologi, Vol. xii., No. 15, 1920.

This species has been referred to the genus *Leucotermes* by the authors referred to above. The type series appears to have been lost and no other specimens are known in Australian collections.

Genus Microcerotermes Silvestri.

List of described Australian species of *Microcerotermes* :

	Locality.	Described Castes.		
		Imago.	Soldier.	Worker.
Microcerotermes serratus (Frogg.)	North Queensland ..	×*	×†	×†
,, *turneri* (Frogg.)	South Queensland and New South Wales	×	×†	×
,, *distinctus* Silv.	Western Australia and South Australia	×*	×	×†
,, *nanus* (Hill) ..	Northern Territory ..	×*	×†	×†
,, *parviceps* Mjöb.	South Queensland ..	×†	×	×†
,, *excisus* Mjöb.	South Queensland ..	×†	×†	×†
,, *leai*, n. sp. ..	South Australia, Victoria and New South Wales	×*	×*	×*
,, *nervosus*, n. sp.	Northern Territory ..	×*	×*	×*
,, *newmani*, n. sp.	Western Australia ..	×*	×*	×*
,, *gladius*, n. sp.	North Queensland ..	..	×*	×*
,, *boreus*, n. sp.	Northern Territory and ? Victoria	×*	×*	×*
,, *fugax*, n. sp.	Northern Territory ..	×*	×*	×*
,, *taylori*, n. sp.	North Queensland ..	×*	×*	×*
,, *mendicus*, n. sp.	North Queensland ..	×*	×*	×*

* Described in this paper.——† Type or co-types examined.

Microcerotermes serratus (Froggatt).

Proc. Linn. Soc. N.S.W., Vol. xxii, 1897 (nec Haviland, Jr. Linn. Soc. Lond., Vol. xxvi, 1898).

Plate II., figs. 57–63 ; Plate V., fig 179 ; Plate VIII., fig. 180.

Imago.

Colour.—Head and thorax dark bay ; abdomen and pleura a little lighter ; postclypeus much lighter than head (Sudan brown), anteclypeus hyaline ; labrum yellow ; antennae, palpi and legs Dresden brown, coxae, femora and tibiae suffused with much darker brown ; sternites of abdomen mummy brown ; wings light fuscous.

Head.—Small, hemispherical behind the eyes, narrowed from the eyes to the base of the clypeus ; very setaceous, a few of the setae, especially near the eyes, very long. Labrum narrow at the base, swelling out on the sides to the rounded apex, the apex and sides hyaline, a few long and numerous short setae about the middle. Clypeus large, markedly convex, hemispherical behind, straight in front, moderately setaceous, suture distinct. Eyes small, prominent, circular (0·221 × 0·221), separated from the lower margin of the head by a space equal to the short diameter of the ocelli. Ocelli small, broadly oval, well separated from the eyes. Antennae (Fig.

57) 14-jointed ; the 1st joint short and stout ; 2nd much shorter and narrower ; 3rd smallest of all ; 4th to 12th moniliform, increasing in size progressively : 13th and 14th about as long as 12th : 14th broadly oval.

Thorax (Fig. 58).—Pronotum of typical form, markedly setaceous, many of setae large, larger than any on head. Meso- and metanotum very setaceous, but none of the setae very large ; the posterior margin of these sclerites irregular in form, often malformed or serrate as though damaged in adolescence.

Wings.—Wing-stumps densely setaceous, as in pronotum, suture nearly straight. Wings (Figs. 179, 180) long and narrow ; the margin very setaceous ; the two anteriormost veins and the first five or six branches of the cubitus much darker than the membrane ; the other veins indistinct but discernible to their extremity ; the radial sector very setaceous along its entire length, the membrane near its base suffused with dark brown ; the media with three or four branches ; media of hindwing branching from the radial sector well beyond the suture ; the cubitus with nine to thirteen branches. Membrane moderately setaceous and densely covered with micrasters.

Legs.—Short and moderately stout, very setaceous ; spurs and claws long and slender.

Abdomen.—Long and narrow, densely setaceous ; the spiracles distinct.

Measurements.—	mm.
Length with wings	7·50–8·00
,, without wings	4·25–4·50
Head, from base to apex of labrum, long ..	0·85–0·93
,, from base to clypeofrontal suture, long ..	0·51–0·56
,, wide	0·81
Pronotum, long	0·39
,, wide	0·64
Wings, forewings, long	6·25
,, ,, wide	1·53
,, hindwings, long	6·25
,, ,, wide	1·53
Tibia iii, long	0·76–0·85
Abdomen, wide	1·00

Queen.

Total length, 18·50 mm. ; abdomen, wide, 3·50 mm.

Soldier.

The soldiers vary somewhat in the size and shape of the head (cf. Figs. 59, 60 and 61), the figure on right representing the commonest form), but as a rule there is little variation in members of

the same colony. The measurements recorded here are of specimens from thirteen colonies in which the alate form or queen is present to confirm diagnosis. The original description and figure of the pronotum of this caste is misleading; in reality the anterior margin is not truncate but quite typical, i.e., bent up, and the anterolateral angles are narrowed as shown in Fig. 60. The antennae have elongate joints (see Fig. 63).

Measurements.—	mm.
Total length	4·75
Head, with mandibles, long	2·05–2·73
,, base to labral suture, long	1·19–1·60
,, wide	0·80–1·00
Mandibles, from external articulation, long ..	0·85–1·08
Antennae, long	1·25
Pronotum, long	0·28
,, wide	0·51–0·56
Tibia iii, long	0·71

Locality.—North Queensland: Torrens Creek, Pentland (G. F. Cook), Townsville and Magnetic Island (G.F.H.); New South Wales (received from Prof. Holmgren).

Identification.—The identification of the above-mentioned specimens is based on a comparison of soldiers and workers from Torrens Creek (type locality) and Pentland (50 miles from Torrens Creek) with co-types in the South Australian Museum collection. The colony from Pentland includes alate imagos, which agree with those in ten colonies from Townsville and Magnetic Island.

Affinities.—This species is most closely related to *M. boreus* (q.v.). It is also allied to *M. parriceps*, but the latter is more reddish in colour, has slightly larger eyes and much smaller ocelli.

Biology.—Fences, house piles, timber bridges, &c., are often seriously damaged by these termites, the presence of which is generally indicated by small external covered-ways or "tubes," or by more or less extensive envelopment of exposed surfaces by a sheathing composed of triturated wood and earth. Although the interior of the wood, and especially the buried portion, is most severely damaged, much of their food appears to be derived from the weathered surfaces of hardwood timber, in cracks and crevices in fences or dead forest trees and bushes and other similar places, where one may see the freshly-gnawed surface in advance of the protective "tube" or sheathing. This surface feeding is of little consequence as a rule, but very often when the colony is situated in a slab or picket fence, for example, the operations are extended to the concealed parts between pickets and rails, or to the mortices, and thence into the solid wood. Painted surfaces appear to be immune from attack. The following notes will convey some idea of the habits of this

species :—Townsville, 19.1.20 : Following a heavy fall of rain on the previous night, a great number of imagos were seen about 8 a.m., either on the wing or running about the ground or fences in de-alated pairs. In most instances de-alation was effected by the wings adhering to wet fences or grass ; in others in the usual way, i.e., by a backward thrust of the wings against the ground, first on one side and then on the other. The source of the flight could not be ascertained, but it appeared that " swarming " was taking place simultaneously from many colonies situated in the soil near the heavily infested and more or less dilapidated fence enclosing the allotment. The life of most of the individuals taking part in the flight was very short owing to the attacks of small ants (*Pheidole megacephale*) which pounced upon most of them as soon as they settled on ground or fences after their short, erratic flight. " Swarming " continued throughout the morning, but it was not until noon that the actual emergence from the ground was witnessed. About this time many imagos were seen flying from under the house, which was built 4 feet from the ground on blocks, and they were traced to a small circular opening in the sandy soil near one of the supporting piles. Three or four soldiers and about a dozen workers were congregated outside the opening, from which the imagos fluttered in rapid succession. A search was made for the nest, but it was not found until the following year, when it became necessary to replace the pile owing to its partial destruction by *Mastotermes*. In the interval the soil in the immediate vicinity had been poisoned with arsenite of soda and all traces of termite life had disappeared. The nest consisted of a small mass of cells constructed of a woody composition and occupying a portion of the space formerly taken up by the sapwood. On 10th December of the same year, while the soil was still damp from heavy showers which fell on the 8th, diurnal " swarming " was again observed on this allotment. In many cases there were as many as four surface openings to each colony, from which the imagos poured as rapidly as they could pass out ; in others there was but a single opening. Workers were plentiful near the exits, but soldiers were either scarce or absent. No further " swarming " took place during the remainder of the wet season of 1920–1921, but on 13th March several alate imagos were captured in the covered-ways on the adjacent fences. The next " swarming " occurred here from 25th to 29th December following, between which dates over 5 inches of rain fell, mostly in heavy showers of short duration. The flights emerged between 8.30 a.m. and 6 p.m. and always immediately after a shower. On 26th and 27th November, 1920, and 9th November, 1922, several colonies, including many alate imagos, were found on Magnetic Island (4 miles from Townsville) in dead tree trunks on the flat, sandy country near the beach, and in the stems of small dead shrubs on the hill-sides. The latter were almost completely destroyed from the roots to the extremity

of the branches, only the bark remaining undamaged. In all the colonies workers and imagos were very numerous, outnumbering the soldiers by several hundreds to one. Surface termitaria appear to be rarely constructed by this species, none having been found in the Townsville District, where the species is commonly met with. The specimens collected at Pentland were from a nest described as "a small, pointed mound, 6 inches high by 5 inches across the base, found in well-drained open forest country." Two colonies were found near Townsville in the lower part of small termitaria of *Hamitermes wilsoni* Hill. In both instances a portion of the earthy material forming the original nest had been removed and replaced by a mass of woody material in which the cells were unusually large for such a small species, i.e., from $1\frac{1}{2}$ to 2 inches across by $\frac{3}{4}$ inch high. The queen occupied a somewhat smaller cell surrounded by large ones occupied by soldiers, workers and many nymphs. The latter show the first evidence of the developing wing-buds late in June or early in July.

Type imago, with associated soldiers and workers, in the National Museum of Victoria.

Microcerotermes turner (Froggatt).

Proc. Linn. Soc. N.S.W., Vol. xxii, 1897. Mjöberg Arkiv. för Zoologi. Vol. xii, No. 15. 1920.

A small colony of soldiers and workers taken under a log in the Blackall Ranges, South Queensland (F. E. Wilson, October, 1920), with *Leucotermes sp.* (soldiers and workers), agree with co-types (from Mackay, Queensland) and with specimens from the collections of Prof. Holmgren and Dr. Mjöberg, from New South Wales and Queensland respectively.

Microcerotermes distinctus Silvestri.

Die Fauna Südwest-Australiens, Bd. ii, Lief. 17, 1909. Mjöberg, Arkiv. för Zoologi. Vol. xii, No. 15, 1920.

Plate II., figs. 64–66; Plate V., fig. 181; Plate VIII., fig. 182.

Imago.

Colour.—Very dark brown, head and pronotum darkest; post-clypeus and labrum somewhat lighter than abdomen; anteclypeus yellow; palpi and legs dark, darker than antennae; under surface dark brown; apical margin of tergites and sternites and the tarsi testaceous. The whole insect rather densely clothed with pale setae.

Head (Fig. 64).—Large, broadly rounded behind, flat on summit, frons concave. Postclypeus large, about half as long as wide, markedly convex, rounded behind, with a distinct suture, anterior margin broadly truncate, with scattered setae; anteclypeus very

short, anterior margin slightly produced in the middle. Labrum short and wide, widest across the middle, broadly rounded in front, with scattered moderately long setae. Palpi very dark, apex of terminal joint pale. Eyes small (0·187 diameter), circular, prominent, finely facetted, separated from the lower margin of the head by a space equal to half their diameter. Ocelli small, broadly oval, well separated from the eyes. Antennae (Fig. 66) 14-jointed; the 1st joint short, one-fifth longer than wide: 2nd half as long as 1st, a little longer than wide; 3rd very short and narrow; 4th to 13th increasing in size progressively; 14th longer than 13th, about as long as 1st. Fontanelle represented by a linear prominence.

Thorax (Fig. 65).—Pronotum, narrower than head, anterior margin nearly straight and slightly bent up anterolateral angles rounded, sides sloping to the slightly emarginate posterior border. Posterior margin of mesonotum markedly sinuate; that of metanotum very irregular, generally approximating the form shown in figure.

Wings.—Wing-stumps rather densely clothed with long pale hairs. Wings (Figs. 181, 182) light fuscous, with the two anterior veins and the first 5 or 6 branches of the cubitus dark, margin moderately densely ciliate except on the basal one-third of the hind margin. Median vein passing through the wing slightly above the middle, indistinct except at the base, with three or four branches to the posterior border. Cubitus with seven or eight branches, two or three of which are generally branched. Wing-membrane with minute micrasters and numerous small setae; the latter apparently wanting, or almost wanting, on hindwings.

Legs.—Short and rather slender, moderately setaceous.

Abdomen.—Long, narrowed at the base, nearly parallel on the sides from the 3rd to 6th segments, broadly rounded at the apex. Tergites and sternites markedly setaceous. Cerci small.

Measurements.—	mm.
Length without wings	4·50–5·00
Head, base to apex of labrum, long .. .	0·91–0·97
,, base to clypeofrontal suture, long ..	0·57–0·62
,, at and including eyes, wide	0·85
Pronotum, long	0·45
,, wide	0·74
Wings, forewings, long	8·00
,, ,, wide	1·88
,, hindwings, long	7·25
,, ,, wide	1·95
Tibia iii, long	0·78

SOLDIER.

Measurements.—	mm.
Total length	5·10–5·25
Head, with mandibles, long	2·45–2·62
,, wide	0·96
,, deep	0·79–0·85
Mandibles, from external articulation, long ..	0·79–0·85
Antennae, long	1·33
Tibia iii, long	0·74

For other details, see description and figures by Silvestri.

Locality.—South Australia : Western Australia : Merriden.

Described from a small colony from the South Australian Museum collection. The identification is based upon the original description and figures of the soldier and worker castes, and on a comparison of workers with co-types. The latter, however, are of little value for specific diagnosis of closely allied species. The measurements of soldiers differ slightly from those given by Silvestri (" Long. corp. mm. 5·5, long. capitis 2·0, lat. capitis 0·98, altitudo capitis 0·87 long. antennarum 1·32, mandibularum 0·97, tibia iii 0·84 "), but as there is complete agreement in all other respects it has been deemed advisable to refer the South Australian specimens to this species pending an examination of imagos from the type locality (Coolgardie, Western Australia). Styli appear to be wanting in all the specimens examined by the writer. A small nest series of soldiers and workers collected at Merriden, Western Australia, by Mr. L. J. Newman are doubtless correctly referred to this species, although the measurements of the soldiers differ slightly from the above. The soldiers described by Silvestri and those in the South Australian series appear to have a short and wide labrum and there is no visible anteclypeus ; one of the Merriden specimens has a still more retracted labrum, but in the remainder of the series the labrum appears to be much longer and a little narrower and the anteclypeus is very evident The difference in the degree of retraction of these organs and the variation in the size and colour of the head of soldiers from different colonies are apt to be misleading.

Measurements of soldiers from Merriden, Western Australia.—

	mm.
Total length	5·00–5·40
Head, with mandibles, long	2·50–2·80
,, wide	0·85–0·90
,, deep	0·74–0·80
Antennae, long	1·42
Mandibles, from external articulation, long .	0·85
Tibia iii, long	0·68

A very closely allied species, or possibly a small form of *M. distinctus*, is represented in my collection by two colonies of workers and soldiers from Hovea, South-west Australia and Jigalong, North-west Australia (collected by Mr. J. Clark and Mr. J. Hickmer respectively). The measurements of the soldiers are: Length of head with mandibles 2·39; without mandibles 1·48; width of head 0·91. In size they are intermediate between typical examples of *M. distinctus* and *M. newmani* and in gross appearance closely resemble the latter in having long narrow heads and short stout mandibles; they differ, however, as follows:—In having larger heads, stouter mandibles, more rounded labrum (the latter with two long setae at its apex), different arrangement of setae on clypeus longer jointed antennae, pronotum with anterior margin only faintly emarginate and with many more setae.

Type imago in the South Australian Museum.

Microcerotermes nanus (Hill).

Proc. Linn. Soc. N.S.W., Vol. xl, 1915. Instit. Sci. and Ind., Bull. 21, 1921.

Plate II., figs 67–71; Plate VI., fig. 183; Plate IX., fig. 184.

Imago.

Colour.—Head and pronotum chestnut, abdominal tergites auburn, postclypeus and base of mandibles lighter than head (Sudan brown); anteclypeus hyaline; labrum, palpi, antennae, legs and wing-stumps same colour as postclypeus; wings light brown.

Head (Fig. 67).—Very setaceous, some of the hairs noticeably longer than the majority; hemispherical behind the eyes, not noticeably flattened on summit. Clypeus large, markedly convex, rounded behind, truncate in front, with scanty setae; anteclypeus very long, nearly as long as postclypeus, wide at its base but narrowed sharply to the pointed apex. Labrum large, about as long as wide, narrowed at the base, round on the sides and in front, widest across the middle, with a few moderately long reddish setae, the sides and apex hyaline. Antennae 14-jointed; 3rd joint smallest; 4th as long but wider than 2nd, rounded; 5th smaller than 4th. Ocelli moderately large, broadly oval, well separated from the eyes (by a space less than their short diameter). Eyes circular, moderately large (0·187 diameter) and prominent, finely facetted, separated from the lower margin of head by a space equal to that separating the ocelli from the eyes.

Thorax (Fig. 68).—Pronotum very setaceous, narrower than head, anterior margin sinuate and slightly bent up in front, anterolateral

angles rounded, sides sloping to the wide and slightly sinuate posterior margin. Posterior margin of meso- and metanotum markedly sinuate.

Wings (Figs. 183, 184).—The two anteriormost veins parallel and close together, dark; the remaining veins, excepting the first five or six branches of the cubitus, indistinct but discernible to the wing border; the margin densely ciliate excepting along the proximal one-third of hind border; the radial sector with numerous setae along its entire length; the media traversing the wing a little above the middle and reaching the margin near the apex, generally with two or three branches to the posterior margin; cubitus generally with seven branches in the forewing and nine or ten in the hindwing, the last generally branched. Wing-stumps covered densely with setae, as on pronotum; suture nearly straight. Membrane with scattered setae and densely covered with minute micrasters.

Legs.—Short and moderately stout; moderately setaceous.

Abdomen.—Very long and slender, the tergites very setaceous, like pronotum; sternites clay colour, suffused laterally with brown, clothed with short, fine setae.

Measurements.

		mm.
Length with wings	♂	7·00; ♀ 7·50
,, without wings	♂	3·75; ♀ 4·25
Head, to apex of labrum, long		0·85
,, to clypeofrontal suture, long		0·57
,, wide		0·68
,, deep		0·39
Pronotum, long		0·30
,, wide		0·51
Wings, forewings, long		5·47
,, ,, wide		1·42
,, hindwings, long		5·35
,, ,, wide		1·53
Abdomen, wide		0·79

SOLDIER.

Additional measurements.

	mm.
Head, with mandibles, long	1·42
,, wide	0·62
Mandibles, long	0·57
Pronotum, long	0·25
,, wide	0·48
Tibia iii, long	0·47

Locality.—Northern Territory: Darwin.

Biology.—This species was described from a small colony of soldiers and workers taken under a coconut lying upon the ground. The alate form described above was taken (30.10.14) in the same locality from a termitarium of *M. nervosus*. The nest, which was situated on a rocky ridge, was a typical example for the species and contained numerous heads of soldiers and workers of the original occupants, most of which were found in disused galleries near the apex of the structure. The present species (*M. nanus*), which was represented by a fairly numerous colony of soldiers, workers and alate imagos, shared the lower half of the nest with an equally numerous colony of soldiers and workers of *Mirotermes sunteri*, n. sp. Another colony, containing soldiers, workers and nymphs, was found in the vicinity of the above (9.9.13) in an occupied termitarium of *Mirotermes melvillensis* Hill. In this instance, too, the little *Microcerotermes* appeared to be the aggressors, since the greater part of the nest was in their possession and there were may heads of the original occupants stored in the disused galleries. The termitarium which was built in a cluster of giant bamboos, was 14 inches high and of irregular shape owing to its lateral extension amongst the adjacent bamboos.

A (?) variety of this species occurs in a collection of termites made by Rev. G. A. Luscombe on Banks Island, Torres Strait. The alate form is not available for comparison, but a first-form queen differs from the type series in the following respects:- Slightly larger; labrum yellow; palpi, atennae, legs and wing-stumps clay colour; pronotum and tergites of abdomen Sudan brown; postclypeus not so convex and shorter (typical—0·204 long by 0·340 wide; variety 0·170 long); antennae with 4th joint very little larger than 3rd, with which it is fused. The measurements of the island form (queen) are as follows:—

	mm.
Total length	15·50
Head, from base to apex of labrum, long	0·91
,, to clypeofrontal suture, long	0·68
,, wide	0·74
Pronotum, long	0·34
,, wide	0·58
Tibia iii, long	0·64
Abdomen, wide	3·00

The soldiers associated with the above differ appreciably from the typical form in both size and shape of the head (cf. Figs. 69 and 70), the former being longer, wider and more rounded on the sides, but the gula is alike. The form of the antennae appears to be fairly constant in the variety (3rd joint smallest, sometimes more or less fused with 4th; 5th to 8th increasing in size progressively); but in the typical form the above segmentation occurs rarely, the

commonest segmentation being—3rd as long as or longer than 2nd, often longer than 5th ; 4th shortest, but not markedly so, not fused with 3rd ; 5th to 9th progressively longer. The termitarium was described as being 9 inches high by 6 inches in diameter at the base, on open, well-drained forest country.

Types (imago, soldier and worker) in the National Museum of Victoria.

Microcerotermes parviceps Mjöberg.

Arkiv. för Zoologi. Vol. xii, No. 15, 1920.

Plate IX., fig. 185.

This and the following species (type locality South Queensland) do not appear to occur in North Queensland or Northern Territory. The soldier is described as having 14-jointed antennae ; all other Australian species have the antennae invariably 13-jointed.

Microcerotermes excisus Mjöberg.

Arkiv. för Zoologi. Vol. xii, No. 15, 1920.

Locality.—South Queensland.

Microcerotermes leai, n. sp.

Plate III., figs. 72–76 ; Plate VI., fig. 186 ; Plate IX., fig. 187.

Imago.

Colour.—Upper surface similar to *M. distinctus* but more reddish ; anteclypeus hyaline ; labrum yellowish brown, distinctly lighter than clypeus ; antennae and palpi dark, but not so dark as in *M. distinctus* ; under surface and legs clay colour, with the sternites suffused with dark brown ; apical margin of tergites and sternites testaceous ; wings light fuscous, much lighter than in *M. serratus* (Frogg.).

Head (Fig. 72). Glabrous, with a few long setae arranged in pairs and many much shorter ones ; small and rather narrow, flat on summit, frons depressed, no indication of fontanelle. Clypeus large, markedly convex and rounded behind, truncate in front, with distinct suture and a few small setae ; anteclypeus very large, about two-thirds wider than long, anterior margin produced in the middle. Labrum small, not covering apex of mandibles, convex, rounded on the sides and in front, with numerous long dark setae. Eyes small (0·204 × 0·204), prominent, finely facetted, a little less than half their diameter from the lower margin of head. Ocelli small, broadly oval, well separated from the eyes. Antennae (Fig. 73) 14-jointed 2nd joint large, five-sevenths as long as 1st ; 3rd very short and narrow ; 4th longer and wider than 3rd, shorter and narrower than

5th, which is equal to or a little larger than 6th ; 6th to 8th increasing progressively ; 9th to 12th about equal, turbinate ; 13th a little longer than 12th ; 14th about as wide as 13th, but longer.

Thorax.—Pronotum (Fig. 74) glabrous, moderately setaceous on sides and in front ; the middle with very few setae, the anterior margin slightly sinuate with the extreme edge bent up, anterolateral angles bluntly rounded, sides sloping to the slightly sinuate posterior margin. Meso- and metanotum (Fig. 75) with the posterior margin markedly sinuate.

Wings.—Wing-stumps small, moderately setaceous, about as long as their respective nota. Wings (Figs. 186, 187) small and slender : with two anterior veins, the base of the median and the first five to seven branches of the cubitus distinct. The membrane densely covered with micrasters and with many minute setae on forewings, the latter wanting or very few on hindwings.

Legs.—Short and moderately slender ; rather setaceous.

Abdomen.—Long and slender, narrow at the base, nearly parallel from the third to sixth segments, bluntly rounded at apex ; the tergites and sternites markedly setaceous. Cerci small.

Measurements.—		mm.
Length with wings	♂	7·50 ; ♀ 7·75
,, without wings	♂	4·25 ; ♀ 4·75
Head, from base to apex of labrum, long		0·97
,, to clypeofrontal suture, long ..		0·57
,, wide		0·79
Antennae, long		1·14
Pronorum, long		0·39
,, wide		0·68
Wings, forewings, long		5·70
,, ,, wide		1·50
,, hindwings, long		5·40
,, ,, wide		1·65
Tibia iii, long		0·74
Abdomen, wide		0·95

Soldier.

Colour.—Head and labrum orange rufous, mandibles uniform reddish brown, antennae yellow ochre.

Head (Fig. 76).—Longer than wide, widest across the middle, slightly rounded on the sides, postero-lateral margin rounded to the truncate posterior margin, the entire surface almost devoid of setae. Clypeus large, truncate in front, with two moderately long and a few very short setae, the former near the apex : anteclypeus short, sometimes concealed. Labrum wide at the base, a little wider

than long, conical, pointed at apex, where there is a group of short setae. Mandibles very long and slender, nearly straight to near the tips, very little widened at the base, the inner margin serrate. Antennae 13-jointed ; the 2nd about one-half as long as 1st and much narrower ; 3rd shortest of all ; 4th longer and wider than 2nd, a little longer than 5th ; 5th to 8th about equal in length ; 9th to 11th a little shorter ; 12th as long as 2nd. 13th a little longer.

Thorax.—Pronotum with anterior one-third elevated and with a slight notch in middle ; anterolateral angles produced ; sides rounded to the posterior margin, which is slightly sinuate ; the margin with a scanty fringe of moderately long pale setae. Meso- and metanotum broadly rounded and fringed as in pronotum.

Legs.—Short, femora moderately stout, with scanty setae.

Abdomen.—Widest across the middle, pointed at the apex ; with scattered pale setae. Cerci small.

Measurements.—

	mm.
Total length	5·00
Head, with mandibles, long	2·40–2·50
,, wide	0·85
,, deep	0·57–0·62
Mandibles, from external articulation, long ..	1·08
Pronotum, long	0·34
,, wide	0·57
Tibia iii, long	0·62

Worker.

Colour.—Head ochraceous orange, clypeus and labrum paler ; vertex, thorax, legs and antennae light ochraceous buff ; a dark ferruginous spot at the articulation of the mandibles.

Head.—Widest at the antennal fossae, narrowed slightly to the broadly rounded posterior margin, with very few setae. Clypeus similar to imago, five-eights as long as wide, with four setae near anterior margin ; anteclypeus large, the anterior margin slightly produced in the middle. Labrum short, broad and strongly convex, widest at the posterior third, with eight to ten moderately long setae towards the apex. Antennae 13-jointed ; the 3rd joint shortest and narrowest.

Thorax.—Pronotum similar to soldier, but with fewer setae.

Legs.—Short and moderately stout ; with scattered setae.

Abdomen.—Rather slender, narrowed at the base, bluntly pointed at the apex, with scanty pale and mostly short setae. Cerci small, wide at the base, apical joint slender.

Measurements.—	mm.
Total length	4·00
Head, to apex of labrum, long	1·08
,, to clypeofrontal suture, long	0·62
,, wide	0·80
Pronotum, long	0·32
,, wide	0·56
Tibia iii, long	0·68

Locality.—South Australia: Ooldea (type locality); Victoria: Violet Town; New South Wales: Pilliga Scrub.

Described from a small colony (collected by A. M. Lea) in the South Australian Museum collection. The Victorian specimens (collected by C. Oke, July, 1924, and the New South Wales specimens collected by W. W. Froggatt, 30.10.24) are almost certainly correctly referred to this species.

Affinities.—The imago appears to be most closely allied to *M. parviceps* Mjöb., from which species it is differentiated by its smaller and less prominent eyes, markedly less hairy head, thorax and abdomen, smaller and paler wings and entirely different wing micrasters (cf. Figs. 185 and 187). The soldiers of these two species have not been compared, but Mjöberg's figure indicates a marked difference in the shape of the mandibles. The Queensland species, moreover, has 14-jointed antennae (13-jointed in all other Australian species).

Types (imago, soldier and worker) in the South Australian Museum.

Microcerotermes nervosus, n. sp.

Plate III., figs. 77–81; Plate VI., fig. 188; Plate IX., fig. 189; Plate VII., fig. 218.

Imago.

Colour.—Chestnut, head a little darker than pronotum and abdomen; postclypeus tawny olive; antennae, mouth parts and legs clay colour; pleura and sternites suffused with brown; wings light fuscous (as in *M. leai*).

Very similar to *M. parviceps* Mjöb. in colour, &c., but smaller and lighter coloured; eyes as in *M. parviceps*, i.e., small, circular (0·204 × 0·204), rather prominent, 0·085 from lower margin of head; ocelli as in *M. parviceps*, very small, widely separated from the eyes, i.e., by a space equal to their long diameter. Antennae (Fig. 77) 14-jointed, the joints short and wide, the 14th as wide as 13th.

Wings (Figs. 188, 189).—Distinctly smaller and paler than in *M. parviceps* (cf. Fig. 185); the micrasters smaller and fewer; more like *M. leai* in gross appearance.

Legs.—Short and moderately stout, with few setae on femora; tibiae moderately setaceous; tibial spurs and claws long and slender.

Abdomen.—Long and narrow, very setaceous. Cerci with short and wide basal joint and short, narrow apical joint.

Measurements.—		mm.
Length with wings ..	♂ 7·25; ♀	7·75–8·00
,, without wings	♀ 4·10–4·45; ♀	4·56–4·86
Head, from posterior margin to apex of labrum, long		0·91–0·97
,, from posterior margin to clypeofrontal suture, long		0·62
,, at and including eyes, wide		0·80
Antennae, long		1·19
Pronotum, long		0·40
,, wide		0·62
Wings, forewings, long		5·75–6·45
,, ,, wide		1·53–1·71
,, hindwings, long		5·50–6·00
,, ,, wide		1·60–1·70
Tibia iii, long		0·68
Abdomen, wide		1·00

Queen.

Total length, 23·00 mm.; abdomen, wide, 5·00 mm.

Soldier.

Colour.—Head uniform Sandford's brown; mandibles very dark, nearly black; thorax, legs and antennae clay colour.

Head (Fig. 79).—Very long and narrow, parallel on the sides, very little narrowed to the articulation of the mandibles. Mandibles (Fig. 80) very short and moderately stout, a little more than half as long as the remainder of the head, only slightly curved, finely serrated, a very small but distinct tooth at the proximal third, sometimes obscured by labrum. Labrum short and wide, parallel on the sides, bluntly pointed at the apex, with a group of ten moderately large setae arranged in pairs, apparently constant. Clypeus with two pairs of hairs on the anterior half; one pair on the anterior margin of the frons; remainder of head with very few setae. Gula long and narrow, the narrowest part one-fifth as wide as head. Antennae (Fig. 81) 13-jointed, longer than mandibles; 4th and 5th joints equal, or 4th a little larger than 5th; 6th to 12th more elongate; 13th long and pointed.

Thorax.—Pronotum with very few setae, small, anterior third elevated and slightly emarginate in the middle; the anterolateral angles narrowed; the sides sloping acutely to the truncate posterior margin.

Legs.—Short; femora stout; tibiae slender; with very few setae; tibial spurs short and stout, 3 : 2 : 2; claws short and stout.

Abdomen.—Small, narrow at the base, widest in the middle, abruptly tapered posteriorly, with numerous mostly very fine setae. Cerci moderately large, wide at the base, apical joint long and slender. Styli very small.

Measurements.—	mm.
Total length	4·50–5·00
Head, with mandibles, long	2·28
,, wide	0·85
,, deep	0·74
Mandibles, long	0·85
Antennae, long	1·25
Pronotum, long	0·34
,, wide	0·60
Tibia iii, long	0·68
Abdomen, wide	0·85

Worker.

Colour.—Large form: Head and postclypeus ochraceous orange, the latter with a large dark ferruginous area at the articulation of the mandibles; anteclypeus hyaline; labrum light orange yellow; antennae, thorax and legs cream buff. Small form: Similar to the above, but paler; frons white.

Head.—With very few setae, but more than in soldier; nearly parallel on the sides, broadly rounded behind. Postclypeus markedly convex, hemispherical behind, truncate in front, with a distinct ferruginous median suture and a few rather large setae. Anteclypeus large, about half as long as postclypeus, nearly truncate in front. Labrum small, markedly convex, narrow at the base, widest in the middle, rounded in front. Antennae 13-jointed; the 1st joint short and stout; 2nd stout, a little more than half as long as 1st; 3rd shortest; 4th to 8th moniliform; 9th to 12th more turbinate; 12th noticeably longer than 11th, but shorter than 13th.

Thorax.—Pronotum similar to that of soldier, but the posterior part shorter and the whole slightly more setaceous. Posterior margin of meso- and metanotum with a scanty fringe of setae as on pronotum.

Legs.—Short and moderately stout, with very few setae excepting at apical fourth of tibiae. Spurs and claws short and stout.

Abdomen.—Widest in the middle, bluntly pointed at the apex; moderately setaceous, most of the setae very short and fine. Cerci and styli as in soldier.

Measurements.—

	Large form.	Small form.
	mm.	mm.
Total length	3·50–4·00 ..	2·90–3·20
Head, to apex of labrum, long ..	0·97–1·00 ..	0·85
,, to clypeofrontal suture, long	0·52–0·68 ..	0·40
,, wide	0·85 ..	0·73
Antennae, long	0·93 ..	..
Pronotum, long	0·25 ..	0·17–0·19
,, wide	0·55 ..	0·42–0·44
Tibia iii, long ..	0·56–0·62 ..	0·45

Locality.—Northern Territory: Darwin (type locality), Stapleton, Brock's Creek, Melville Island, Daly River District (G.F.H.), (?) Groote Eylandt, (?) Maria Island, (?) Connexion Island (N. B. Tindale).

Affinities.—The imago, as stated in the description, is very closely allied to *M. parviceps* Mjöb.: it resembles, also, *M. serratus* (Frogg.), but the latter is more hairy, darker in colour, has darker, longer and relatively narrower wings, different wing micrasters and differently shaped pronotum. The soldier is quite distinct from Froggatt's species; it has, however, some resemblance to *M. newmani*, n. sp., but it is larger and has a distinctly different shaped head, mandibles and gula. Professor Holmgren, who has compared *M. nervosus* with the types of *M. papuanus* Holmgr., from New Guinea, notes the following differences: —"The head of the soldier of *papuanus* is broader and covered with hairs, not very densely but over the whole surface. In your specimens there are a few pairs of hairs to be seen as the head is viewed from the side. The imago of *papuanus* is darker coloured and more hairy and is, also, a little larger."

Biology.—Described from a complete nest-series from a small pointed termitarium about 12 inches in height which was built over and around a large bamboo cut-off about 9 inches from the ground. Alate imagos and many first-form nymphs were present in the nest (28.9.14). The following field notes refer to some of the additional 32 colonies collected by the writer: —(1) Darwin, 5.10.15. A complete series from a small woody termitarium built against the trunk of an introduced ornamental tree. Alate imagos very numerous. No rain fell in this locality during past several months. Second-form nymphs were taken from a similar nest in this vicinity on

9.9.13. Similar nests are common at the base of fence-posts, &c. (2) Daly River, 3.10.14. A complete series from a hardwood farm building; soldiers and workers in sap-wood (damaged by *Bostrychid* beetles) and in woody termitarium 9 feet from the ground between top of pile and floor-joist; imagos in similar nest situated at base of same pile; no external "tubes" on pile, but communication between the two nests maintained by means of passages in the sap-wood. A very destructive species, largely responsible for the destruction of dwellings and sheds in this settlement. (3) Darwin, 24.10.14. A complete series from a nest similar to that illustrated in Fig. 218, on dry, stony hill-side. Alate imagos very plentiful; very few soldiers. A similar nest, containing the same forms, was found here on 19.9.21. (4) 30 miles south-east from Darwin, 30.5.13. Soldiers, workers and queen from pointed, woody termitarium 12 inches high by 3 inches in diameter at base; in corn-field; termiterium known definitely to be less than twelve months old; queen in small, flat cell in centre at ground level. (5) Darwin, 27.1.17. Soldiers and workers from a woody nest, in dry, sandy coastal scrub; nest 25 inches high by 12 inches in diameter at base (see Fig. 218). (6) 34 miles south-east from Darwin, 15.1.13. Soldiers, workers and queen from nest similar to (3), situated amongst suckers from small *Eucalyptus* tree. The type of *Tanychilus opacus* Carter (*Tenebrionidae*) was taken in this nest. (7) Brock's Creek, 8·10·13. A complete series from nest similar to (3), built on exposed root of living tree; alate imagos and first-form nymphs very numerous, soldiers scarce. (8) Stapleton, 4.11.14. Soldiers, workers and queen from nest similar to the above but constructed on tussock of grass on ill-drained, clayey flat; queen in small, flattened cell 2 inches below ground level; many wings in nest and surrounding grass; similar nests plentiful in well-drained forest country in vicinity. (9) Darwin, 5.2.14. Soldiers, workers and queen, from a typical nest built over a small dead stump; nest 12 inches high, with top of stump projecting through the apex; queen cell 37 mm. in diameter by 7 mm. high, with level "floor" and slightly domed "ceiling"; four small entrances to cell; situated 2 inches below surface level of ground and in the centre of nest. (10) Stapleton, 4.11.14. A complete series from a typical nest. Alate imagos commenced to emerge at 4.30 p.m. (after a heavy shower of rain) from many small, circular openings in various parts of the nest from near the ground to the apex; these openings were guarded by soldiers, whose heads only projected from the nest, and were closed by workers after the "swarming" ceased; numerous apparently fully developed imagos did not leave the nest during this flight; many nests of this species were opened in this locality on 27.10.13, when they contained alate imagos. (11) Darwin, 28.9.13. A similar occurrence to that recorded above was observed during very windy weather 24 hours after heavy rain; males and females settled on the ground after a

short, feeble flight and immediately shed the wings ; the former then followed the latter for varying periods up to fifteen minutes, when each pair secreted themselves under pieces of wood or bark or in tussocks of grass.

Types (imago, soldier and worker) in the National Museum of Victoria.

Microcerotermes newmani, n. sp.

Plate III., figs. 82–84 ; Plate VI., fig. 190 ; Plate IX., fig. 191.

Imago.

Colour.—Head, thorax and abdomen argus brown ; middle of thoracic nota and fifth to eighth abdominal tergites paler ; postclypeus much lighter than head, clay colour ; labrum, antennae, legs, pleura and sternites of abdomen a little paler than postclypeus ; wings light fuscous.

In gross appearance very like *M. leai*, n. sp., but distinctly smaller and easily differentiated by the following characters :—Head not quite so reddish and more hairy ; eyes a little larger ; antennae, mouth-parts, legs and under surface distinctly paler ; pronotum lighter in colour, smaller and differently shaped ; wings about the same length but distinctly wider and rather darker ; wing micrasters different (cf. figs. 187 and 191). Antennae (Fig. 82) 14-jointed ; 1st joint twice as long as wide ; 2nd large, as long as 1st is wide ; 3rd very short and narrow ; 4th short and wide, as wide as 2nd ; 5th markedly larger than 4th, as wide as, but more quadrate than, 6th. Pronotum (Fig. 83) nearly straight in front, with slight emargination in middle, anterior margin elevated, anterolateral angles and sides rounded, posterior margin sinuate, the entire surface covered with long and short setae. Posterior margin of meso- and metanotum markedly sinuate. Wings (Figs. 190, 191) short and wide, the radius, radial sector and extreme proximal end of median vein and the first five or six branches of the cubitus dark ; the radial sector with numerous moderately long setae along its entire length ; the median vein branched from the radial sector well beyond the suture in the hindwing ; membrane with scattered setae and densely covered with very distinct micrasters.

Measurements.—

		mm.
Length with wings	♂	7·25 ; ♀ 8·00
,, without wings	♂	3·87 ; ♀ 4·10
Head, from base to apex of labrum, long..		0·85
,, from base to clypeofrontal suture, long		0·51
,, wide		0·74
Eyes, diameter, laterally		0·238
,, ,, vertically		0·221

Measurements—continued.	mm.
Pronotum, long	0·40
,, wide	0·54
Wings, long	5·70–6·25
,, wide	1·65–1·93
Tibia iii, long	0·62

Soldier.

Colour.—Head uniform ochraceous tawny: thorax, legs, and antennae chamois yellow.

Head (Fig. 84).—Long and narrow, parallel on the sides, broadly rounded behind, with very few and very short setae. Anteclypeus short and wide, arcuate in front. Labrum large, a little wider than long, parallel on the sides, broadly rounded at the apex, with a group of moderately large setae in the middle of the apical fourth. Mandibles short and very stout, curved, serrate. Antennae 13-jointed, about as long as mandibles; 3rd joint smallest; 4th and 5th nearly equal; 6th to 13th progressively longer; 13th narrow, as long as 1st. Gula wide, nearly one-fourth as wide as head at narrowest part.

Thorax.—Pronotum small, with few setae, mostly near margin, some of those near lateral angles very long, the anterior fourth narrowed and elevated, with deep emargination in the middle, the anterolateral angles produced, the sides nearly straight to the broadly truncate or slightly sinuate posterior margin. The meso- and metanotum with scanty fringe of long setae and with nearly straight posterior margin.

Legs.—Short and moderately stout, with few setae.

Abdomen.—Long and narrow, with scanty, short and long setae. Cerci large. Styli apparently wanting.

Measurements.—	mm.
Total length	4·20–4·45
Head, with mandibles, long	1·99–2·10
,, without mandibles, long	1·30–1·42
,, deep	0·62
,, wide	0·74
Gula, at narrowest part, wide	0·20
Mandibles, from external articulation, long ..	0·68–0·74
Antennae, long	1·02
Pronotum, long	0·23
,, wide	0·52
Tibia iii, long	0·57

Worker.

Colour.—Head buff yellow; frons, antennae, thorax and legs cream; a dark reddish spot at articulation of mandibles.

Head.—Moderately hairy, the hairs mostly short; parallel on the sides, broadly rounded behind, widest in line with the insertion of the antennae. Postclypeus large, convex, markedly rounded behind, truncate in front, with fairly distinct median suture and about twelve reddish setae; anteclypeus large, the anterior margin produced in the middle. Labrum moderately large, convex, narrowed at the base, swollen on the sides to the rounded apex, a group of about eight short, moderately stout hairs near the apex. Antennae 13-jointed, segmentation similar to that of imago.

Thorax.—Pronotum similar to that of soldier, but with fewer setae. Posterior margin of meso- and metanotum broadly rounded or nearly truncate, with a scanty fringe of long, pale setae as on pronotum.

Legs.—Short and moderately stout, clothed similarly to abdomen.

Abdomen.—Long and narrow, with scanty, pale setae. Cerci large.

Measurements.—

	mm.
Total length	3·64
Head, to apex of labrum, long	0·97
,, to clypeofrontal suture, long	0·60
,, wide	0·74
Pronotum, long	0·25
,, wide	0·51
Antennae, long	0·85
Tibia iii, long	0·50
Abdomen, wide	0·90

Locality.—South-west Australia: Mundaring (type locality), Wongong, Hovea, Gosnells; North-west Australia: Broome.

The imago and worker are described from a nest-series without soldiers; the latter caste is described from a nest-series (from the same locality) containing a first-form king and queen which agree in every respect with the type imago. Fifteen colonies have been examined, of which number twelve are without imagos. Of the latter number one was associated with *Eutermes apiocephalus* Silv. (Mundaring, C. F. Hill, 18.10.20) and two with *Coptotermes* sp. (Hovea, J. Clark). One small series received for identification from Mr. L. J. Newman, Government Entomologist, was found destroying a cotton plant at Broome.

Affinities.—The similarity of the imago to *M. leai*, n. sp. has been noted; the soldiers, however, are quite distinct (cf. Figs. 76

and 84). The soldier of *M. newmani* most closely resembles certain small forms of *M. distinctus* (or an allied species), under which species the distinguishing features are discussed.

Types (imago, soldier and worker) in the National Museum of Victoria.

Microcerotermes gladius, n. sp.

Plate III., figs. 85, 86.

Soldier.

Colour.—Head hazel behind, deepening to chestnut anteriorly: anteclypeus hyaline; labrum same colour as back of head; antennae, thorax and legs cream buff.

Head (Fig. 85).—Longer than wide, sides nearly parallel, broadly rounded behind, with very few long and short setae, the latter most numerous on frons and vertex. Mandibles short and stout, strongly curved, finely serrated. Anteclypeus slightly produced in the middle, variable in length. Labrum large, wide at the base, sloping to the bluntly pointed apex. Antennae (Fig. 86) 13-jointed, longer than the mandibles; 1st joint long and slender; 2nd about half as long as 1st; 3rd smallest of all; 4th to 7th increasing in length progressively; 8th to 12th narrow at the base, slightly turbinate; 13th about as long and wide as 12th, widest in the middle. Gula (Fig. 85) short and very wide, two-fifths as wide as head at its widest part.

Thorax.—Pronotum (Fig. 85) small, of typical form, with scanty fringe of setae around margin.

Legs.—Short and moderately slender, with very few setae on femora, rather more on tibiae.

Abdomen.—Long and slender, widest in the middle, tapered to the bluntly pointed apex, moderately setaceous, the hairs mostly very short and fine, longer on apical segments. Cerci moderately long and slender.

Measurements.—	mm.
Total length	4·00–4·20
Head, with mandibles, long	1·82–2·16
,, without mandibles, long	1·25
,, base to labral suture, long	1·88–2–22
,, deep	0·68–0·74
,, wide	0·85
Mandibles, long	0·85
Antennae, long	1·25
Pronotum, long	0·30–0·36
,, wide	0·54–0·59
Tibia iii, long	0·70
Abdomen, wide	0·85

Worker.

Colour.—Head clay colour; frons, antennae, legs and thorax cream.

Head.—Widest in line with the insertion of the antennae, narrowed to the base of the mandibles, broadly rounded behind, with very few setae. Postclypeus large, about twice as wide as long, rounded behind, truncate in front, with a few setae near anterior margin and a large reddish spot at the articulation of the mandibles. Anteclypeus large, as long as postclypeus, markedly produced in the middle. Labrum small, strongly convex, with a group of small setae about the middle of apical half, narrowed at the base, rounded on the sides to the rounded apex. Antennae 13-jointed; 2nd joint large, nearly as wide and two-thirds as long as 1st; 3rd very short and narrow.

Thorax.—Pronotum similar to that of soldier.

Legs.—Short and slender, with few setae.

Abdomen.—Widest in the middle, tapered to the bluntly rounded apex, moderately setaceous. Cerci moderately long and slender.

Measurements.—

	mm.
Total length	3·70–4·00
Head, to apex of labrum, long	1·02
,, to clypeofrontal suture, long	0·57
,, wide	0·81
Pronotum, long	0·27
,, wide	0·47–0·51
Tibia iii, long	0·57
Abdomen, wide	1·14

Apterous Queen.

Colour.—Head russet, with very distinct frontal and transverse sutures; postclypeus paler (buckthorn brown); labrum yellow ochre; pronotum cream suffused with brown at margins; legs and remainder of thorax cream; abdominal tergites cream mottled with brown. Antennae 13-jointed; 3rd joint smallest; 4th to 13th increasing in length progressively. Pronotum somewhat similar to that of worker, but much larger; meso- and metanotum as in worker, i.e., showing no trace of wing-rudiments. Ocelli and eyes entirely wanting (stained preparations examined). Abdomen with seventh sternite long and wide, as in female imago of allied species.

Locality.—North Queensland: Meringa (near Cairns), Palm Island.

Affinities.—The soldiers of this species appear to be most nearly allied to *M. parviceps* Mjöb., from which they differ in their smaller

size, less rounded heads, and 13-jointed antennae. Mjöberg's species is described as having the antennal joints "rounded and short"; in the proposed new species they are rather elongate.

Biology.—Described from a colony collected by Dr. J. F. Illingworth (March, 1921) in the interior of a sugar-cane. There were no eggs or very young larvae in the community, but adolescent soldiers and workers and nymphs with short wing-stumps were numerous. The apterous queen described above, and another somewhat less developed, were clearly not of the usual type, being ergatoid in the form of the head and pronotum. Although the characteristic type of apterous queen is not rare in Australian *Microcerotermes*, the above form has not been found previously by the writer in this or any other genus. The Palm Island specimens (G.F.H., 26.9.20), comprising soldiers and workers only, were found under a log, the interior of which appeared to be considerably damaged by them.

Microcerotermes boreus, n. sp.

Plate III., figs. 87, 88; Plate VI., fig. 192; Plate IX., fig. 193; Plate VII., fig. 219.

Imago.

Similar to *M. serratus* (Frogg.), from which species it is distinguished by its lighter colour, head and thorax more reddish (chestnut), postclypeus distinctly paler, pleura and legs ochraceous tawny, wings much longer and wider, eyes larger and more prominent, ocelli larger and pronotum longer.

Measurements.—	mm.
Length with wings	9·25–9·50
,, without wings	5·25–5·50
Head, base of apex of labrum, long	1·00
,, base to clypeofrontal suture, long	0·59
,, wide	0·85
Eyes, diameter	0·255 × 0·255
Pronotum, long	0·42
,, wide	0·64
Wings, forewings, long	8·25
,, ,, wide	2·10
,, hindwings, long	7·75
,, ,, wide	2·10
Tibia iii, long	0·80
Abdomen, wide	0·34

Queen.

Total length, 21·00 mm.; abdomen, wide, 4·00.

Soldier.

Colour.—Head hazel, darker anteriorly; labrum orange rufous; anteclypeus hyaline; mandibles nearly black; thorax and legs cream buff.

Head (Fig. 87).—Long and narrow, nearly parallel on the sides, with a few short, pale setae. Anteclypeus short and wide, slightly sinuate on anterior margin. Labrum convex, wide at base and narrowed to the bluntly pointed apex. Mandibles (Fig. 88) very long and slender, as long as remainder of head, inner edges markedly serrate. Antennae (Fig. 88) 13-jointed, long and slender, not reaching the apex of mandibles; 3rd joint shortest; 4th to 12th elongate; 13th narrower than 12th and about as long. Antennal carinae heavily chitinized. Gula at its widest part one-fourth as wide as head.

Thorax (Fig. 87).—Anterior one-third of pronotum narrowed and bent up, anterolateral angles produced, sides sloping to the slightly sinuate posterior margin, with very few setae.

Legs.—Short and moderately stout, with few setae.

Abdomen.—Long and slender, widest in the middle, tapered to the pointed apex. Cerci long and slender. Styli wanting.

Measurements.—	mm.
Total length	5·50–6·40
Head, with mandibles, long	2·73–3·07
,, base to labral suture, long	1·42–1·53
,, wide	0·91–0·97
Mandibles, long	1·48
Antennae, long	1·60
Pronotum, long	0·40
,, wide	0·68
Tibia iii, long	0·76

Worker.

Colour.—Head ochraceous buff; postclypeus a little paler; frons, antennae, legs and thorax cream buff.

Head.—Small, widest at the articulation of mandibles, nearly parallel on the sides, broadly rounded behind; with very scanty, pale setae, some of which are fairly long. Postclypeus large, hemispherical, markedly convex, glabrous, anterior margin truncate, a dark ferruginous spot at each end; anteclypeus large, about half as long as postclypeus. Antennae 13-jointed: the 3rd joint smallest. Labrum small, narrow at the base, swollen on the sides and rounded in front.

Thorax.—Pronotum small, much narrower than head, shaped as in soldier; with very few setae, some of which are very long. Mesonotum with posterior margin broadly rounded; metanotum nearly straight.

Legs.—Short and moderately slender; with few setae.

Abdomen.—Long and slender, with scattered mostly short, pale setae, some near apex fairly long.

Measurements.—

	mm.
Total length	4·00
Head, from base to apex of labrum, long	1·02
,, from base to clypeofrontal suture, long ..	0·65
,, wide	0·78
Pronotum, long	0·80
,, wide	0·52
Tibia iii, long	0·57
Abdomen, wide	1·00

Locality.—Northern Territory: Melville Island (type locality), Darwin (G.F.H.); (?) Victoria: Linga (F. E. Wilson).

Affinities.—The imago differs from *M. serratus* (Frogg.) as follows:—The wings are much larger and darker, the pronotum noticeably longer, the eyes much larger and more prominent, the ocelli larger, general colour lighter, postclypeus, legs and pleura distinctly paler. In colour it agrees more closely with *M. parriceps*, but the latter is a smaller species, with much smaller eyes, ocelli and wings, and differently shaped pronotum. From *M. lea*i it differs in its larger size, much longer wings, longer pronotum, larger eyes and larger ocelli. The soldier differs from *M. serratus* in its larger size, longer and more serrate mandibles, wider gula and longer jointed antennae. The latter organ does not reach the tip of the mandibles in the new species, whereas in Froggatt's species it extends well beyond them.

Biology.—Two complete nest-series were taken on Melville Island on 29.10.16 from small, rounded, blackish, woody termitaria (Fig. 219) measuring about 11 inches in height by 9 inches in diameter. In each case about one-half of the structure projected above the surface of the ground and enveloped part of a small stump or root. Alate imagos and workers were plentiful, but soldiers were not numerous. Another community, comprising soldiers and workers only, was taken in Darwin (4.8.14) from "tubes" or covered-ways on a concrete pile 6 feet in height supporting a so-called "white-ant proof" dwelling. Access to the floor-joists was gained by carrying the "tubes" over the top of the pile and through a bolt-hole in the middle of the interposed metal plate. The common practice of fastening floor-joists to the supporting piles by means of a bolt

imbedded in the latter and passing through the metal plate is obviously bad, and should be discontinued in favour of angle-irons attached further down the pile and having sufficient spread to clear the metal plate. The latter to be effective should have cut, not rolled, edges. The Victorian specimens referred doubtfully to this species are somewhat smaller in size and have the labrum wider and less pointed than the majority of the Northern Territory specimens. Measurements :—Total length, 5·50–6·00 ; head, with mandibles, 2·50–2·70 ; head, wide, 0·79–0·85 ; antennae, long, 1·48 ; pronotum, long 0·34, wide 0·57.

Types (imago, soldier and worker) in the National Museum of Victoria.

Microcerotermes fugax, n. sp.

Proc. Linn. Soc. N.S.W., Vol. xl, 1915 (*Termes turneri* Hill, nec Froggatt).

Plate III., figs. 89–94 ; Plate VI., fig. 194 ; Plate IX., fig. 195 ; Plate VII., fig. 220.

Imago.

Colour.—Head chestnut, a shade darker than in *M. nervosus* ; antennae, legs and pleura also a little darker.

Head (Fig. 89).—Differs from *M. nervosus* in being rather more hairy, hairs larger ; eyes similar ; ocelli very little larger (long diameter 0·85 as against 0·68 in *M. nervosus*) and closer to eyes (0·34 as against 0·68 in *M. nervosus*). Antennae (Fig. 92) 14-jointed ; 3rd joint very small ; 4th longer and wider ; 5th and 6th equal, larger than 4th ; 5th to 9th rounded ; 10th to 13th turbinate, short ; 14th about as long and wide as 13th.

Thorax.—Very like *M. nervosus*, but with light-coloured area as shown in Fig. 90. Posterior margin of meso- and metanotum also similar to the above species but generally not so sinuate (cf. Figs. 78 and 91*b*) ; metanotum often variable (cf. Figs. 91*a* and 91*b*).

Wings (Figs. 194 and 195).—Very similar to *M. nervosus* in colour and shape, but the micrasters darker and more numerous and the veins a little more distinct. Venation very variable ; the median of forewing generally with three branches of varying length, sometimes with five branches, rarely with one of them joining the radial sector near the apex of the wing ; cubitus very variable, with from seven to twelve branches, simple or forked, the last branch generally joining the posterior border about the distal third of the wing, but sometimes nearer the proximal third.

Legs.—As in *M. nervosus*.

Abdomen.—As in *M. nervosus*, but more setaceous ; hairs longer. Styli wanting.

Measurements.—

	mm.
Length with wings	8·00–8·50
,, without wings	4·00–5·00
Head, from posterior margin to apex of labrum, long	0·97–1·00
,, from posterior margin to clypeofrontal suture, long	0·45–0·51
,, at and including eyes, wide	0·80–0·85
Eyes, diameter .. 0·204 × 0·204–0·221 × 0·221	
Antennae, long	1·00
Pronotum, long	0·39–0·42
,, wide	0·63–0·73
Wings, forewings, long	7·00–7·50
,, ,, wide	1·48–1·53
,, hindwings, long	6·75–7·25
,, ,, wide	1·48–1·65
Tibia iii, long	0·85
Abdomen, wide	1·00

Soldier.

Head yellow ochre; very like *M. gladius* (cf. Figs. 85 and 93), from which it is distinguished by its lighter coloured and longer head, longer and narrower gula, longer mandibles and pronotum and fewer setae on head. The gula at its narrowest part is about one-fifth as wide as the head (two-fifths in *M. gladius*). Antennae 13-jointed and similarly segmented to the last-mentioned species.

Measurements.—

	mm.
Total length	3·90–4·50
Head, with mandibles, long	2·16–2·62
,, without mandibles, long	1·14–1·48
,, wide	0·80–0·91
,, deep	0.63
Antennae, long	1·08–1·36
Pronotum, long	0·30–0·32
,, wide	0·54–0·57
Tibia iii, long	0·57
Abdomen, wide	0·85

Worker.

Very like *M. gladius*. Head ochraceous orange, with dark ferruginous spot at articulation of mandibles; frons very little lighter than remainder of head. Styli present.

Measurements.—	mm.
Total length	3·30–3·50
Head, posterior margin to apex of labrum, long..	0·93–1·27
,, posterior margin to clypeofrontal suture, long	0·60–0·76
,, wide	0·85–0·91
Antennae, long	1.08
Pronotum, long	0·22–0·32
,, wide	0·46–0·51
Tibia iii, long	0·54
Abdomen, wide	0·91

Locality.—Northern Territory : Stapleton (type locality) ; Darwin, Bathurst Island (G.F.H.).

Biology.—Soldiers from the same colony vary very little in size, but individuals from different nests often show noticeable differences in this respect. In the worker caste there appear to be several intermediates between the small and the large forms. The type series was taken on 1.1.13 from the termitarium shown in Fig. 220, which was composed almost entirely of an intensely hard woody composition and was situated in lightly timbered, undulating country. Alate imagos were numerous and active when disturbed. A second colony was found on the same date in the earthy wall of a termitarium of *Coptotermes acinaciformis* (Frogg.), which also contained colonies of *Mirotermes orbus*, n. sp. and *Hamitermes* (*Drepanotermes*) *septentrionalis* Hill. The following additional colonies were taken in the localities stated : Stapleton, 23.12.12 : A complete series from a termitarium similar to that illustrated by Fig. 220 ; 12 inches high by 4 inches in diameter at the base ; upper part of nest occupied by a colony of ants (*Iridomyrmex sanguineus* Forel). Darwin, 1.4.13 : Soldiers and workers in trunk of coco-nut palm previously damaged by weevils ; trunks of several dead palms were similarly infested. Stapleton, December, 1913 : A small colony, including alate forms, under log. Batchelor, 17.7.13 : Soldiers and workers from a termitarium similar to that illustrated, but constructed of earth and comminuted wood ; on ill-drained, flat country. Stapleton, 5.11.14 : A complete series from a nest composed of comminuted wood and earth, built 4 feet from the ground on the trunk of an *Eucalyptus* tree ; nest connected with ground by a series of passages under a common protective casing of clayey material. Similar nests were very plentiful on the boggy country in the vicinity of a creek ; all contained soldiers, workers and alate imagos, but no queens or eggs (as in typical nests on well-drained country in the near vicinity). These arboreal nests are abandoned during the dry season.

Types (imago, soldier and worker) in the National Museum of Victoria.

Microcerotermes taylori, n. sp.

Plate III., figs. 95–97 ; Plate VI., fig. 196 ; Plate IX., fig. 197.

Imago.

Similar to *M. nanus* (Hill), from which species it is distinguished by its generally darker colour, slightly larger eyes, 13-jointed antennae, and distinctly different wing micrasters.

Head very setaceous, dark bay ; postclypeus distinctly lighter, with dark median suture ; antennae 13-jointed, 3rd joint shortest ; eyes moderately large (0·2040 × ·204), 0·034 from lower margin of head ; ocelli broadly oval, very small (0·050), 0·034 from eyes ; pronotum as in *M. nanus*.

Measurements.—	mm.
Length without wings	4·00
Head, to apex of labrum, long	0·85
,, to clypeofrontal suture, long	0·57
,, wide	0·68
Pronotum, long	0·34
,, wide	0·47
Wings, forewings, long	5·50
,, ,, wide	1·50

Queen.

Total length, 17·00 mm. ; abdomen, wide, 4·00 mm.

Soldier.

Differs from *M. nanus* in having a shorter and narrower head (Fig. 95), sides not so narrowed to base of mandibles, mandibles longer and more slender, labrum shorter and narrower, gula (Fig. 96) one-fourth narrower, markedly narrowed at posterior one-third.

Measurements.—	mm.
Total length	3·40
Head, with mandibles, long	1·80
,, without mandibles, long	1·08
,, wide	0·68
,, deep	0·57
Antennae (13-jointed)	1·10
Gula, at narrowest part, wide	0·15
Pronotum, long	0·25
,, wide	0·42
Tibia iii, long	0·50

Worker.

Head clay colour, with very distinct pale sutures ; postclypeus same colour as head, with very distinct brown median suture, a

large dark chestnut spot at internal articulation of mandibles. Antennae 13- or 14-jointed, 3rd joint shortest, 4th to penultimate joints increasing in length progressively, apical joint markedly longer and a little narrower than preceding one. Differs from *M. nanus* in having much larger spots at articulation of mandibles and a dark median suture in clypeus, head of same colour as *M. nanus* but blotched in appearance, frons same colour as back of head (not whitish).

Measurements.	mm.
Total length	3·70
Head, to apex of labrum, long	0·78
,, to clypeofrontal suture, long	0·45
,, wide	0·60
Pronotum, long	0·20
,, wide	0·45
Tibia iii, long	0·48

Locality. North Queensland : Meringa, near Cairns.

Described from a complete nest series collected by Mr. F. H. Taylor on 31.12.24 from a small termitarium about the size of a human head and situated at the base of a termitarium of *Coptotermes acinaciformis* (Frogg.).

Types (imago, soldier and worker) in the National Museum of Victoria ; paratypes in Mr. Taylor's collection.

Microcerotermes mendicus, n. sp.

Plate III., figs. 98–102 ; Plate VI., fig. 198 ; Plate IX., fig. 199.

Imago.

Differs from *M. serratus* (Frogg.), which species it most closely resembles, in the following characters : Slightly darker in colour, eyes distinctly larger, wings darker (dark fuscous), longer and wider ; differs from *M. parviceps* Mjöb. in its smaller size, larger eyes, smaller and more rounded pronotum ; differs from *M. turneri* (Frogg.) in being much smaller and in having markedly smaller eyes, ocelli and pronotum. The ocelli are 0·068 in length, which is the distance separating the eyes from the lower margin of the head and from the ocelli.

Measurements.		mm.
Length with wings	♂	7·50, ♀ 8·50
,, without wings	♂	4·00, ♀ 4·27
Head, to apex of labrum, long		1·00
,, to clypeofrontal suture, long		0·58
,, wide		0·81
Eyes, diameter		0·221 × 0·221
Antennae (14-jointed)		1·25–1·36

Measurements—continued.	mm.
Pronotum, long	0·30–0·40
,, wide	0·57–0·64
Wings, forewings, long	6·40–7·00
,, ,, wide	1·80–1·88
,, hindwings, long	5·75–6·00
,, ,, wide	1·82–1·93
Tibia iii, long	0·80
Abdomen, wide	0·85

Soldier.

Similar to *M. gladius*, n. sp. but lighter in colour, head a little longer and wider, labrum and gula longer and wider, anteclypeus larger and produced in the middle. If differs from *M. turneri* (Frogg.) in having a smaller, paler, narrower and shallower head, the sides of which are less rounded, the antennae and mandibles more slender; and from *M. excisus* Mjöb. in its smaller size, &c.

Measurements.—	mm.
Total length	4·27
Head, with mandibles, long	2·16
,, without mandibles, long	1·36
,, wide	0·91
,, deep	0·74
Gula, at narrowest part, wide	0·23
Antennae (13-jointed)	1·10–1·20
Pronotum, long	0·34
,, wide	0·57
Tibia iii, long	0·73

Worker.

Colour.—Head chamois, deepening to clay colour behind the transverse suture; transverse suture and a large spot at junction of transverse and frontal sutures whitish; antennae and pronotum same colour as postclypeus, the latter with a small ferruginous spot at each end.

Head.—Longer than wide, widest in front, slightly narrowed to the rounded posterior margin, with scanty strong reddish setae. Postclypeus small, about one-half as long as wide (0·221 × 0·425), strongly convex, median suture not well defined; anteclypeus about half as long as postclypeus, hyaline, anterior margin produced in middle. Labrum short, not as long as clypeus, narrowed at base, very wide in middle, rounded in front. Antennae 13-jointed.

Thorax.—Pronotum very short, moderately wide, with scanty long reddish setae, anterior margin sharply bent up and deeply emarginate, anterolateral angles produced, sides sloping to the strongly emarginate rounded posterior margin.

Legs.—Moderately long and slender, with scanty very short pale setae.

Abdomen.—Large, with very short and fine setae.

Measurements.—	mm.
Total length	4·00
Head, to apex of labrum, long	0·90–0·98
,, to clypeofrontal suture, long	0·68
,, wide	0·84
Pronotum, long	0·25
,, wide	0·56
Tibia iii, long	0·62

Locality.—North Queensland: El Arish (type locality), Meringa (F. H. Taylor).

Described from a small colony taken in a dilapidated termitarium on 10.11.24. One alate imago was taken at a lamp in the last-named locality in December.

Types (imago, soldier and worker) in the National Museum of Victoria; paratypes in Mr. Taylor's collection.

Genus Mirotermes Wasmann.

List of described Australian *Mirotermes*:—

Species.	Locality.	Described Castes.		
		Imago.	Soldier.	Worker.
Mirotermes krisiformis (Frogg.)	New South Wales ..	×	×†	×†
,, *kraepelini* Silv. ..	South-west Australia ..	×*	×	×
,, *melvillensis* (Hill) ..	Northern Territory ..	×*	×†	×
,, *taylori* (Hill) ..	Northern Territory ..	×†	×†	×
,, *froggatti* (Hill) ..	Northern Territory ..	×†	×†	×
,, *harrisi* Mjöb. ..	North Queensland ..	×	×†	×
,, *maideni* Mjöb. ..	North Queensland ..	..	×†	×
,, *cheeli* Mjöb. ..	North Queensland ..	×†	×†	×
,, *alleni* Mjöb. ..	North Queensland ..	..	×†	×
,, *broomensis* Mjöb. ..	North-west Australia ..	..	×†	×
,, *alicensis* Mjöb. ..	North Queensland ..	..	×†	..
,, *septentrionalis*, n. sp.	Northern Territory ..	..	×*	..
,, *infrequens*, n. sp. ..	South-west Australia ..	×*	×*	×*
,, *quadratus*, n. sp. ..	Northern Territory ..	..	×*	..
,, *sanderi*, n. sp. ..	Northern Territory ..	×*	×*	..
,, *banksiensis*, n. sp.	Banks Island (Torres Strait)	×*	×*	×*
,, *orbus*, n. sp. ..	Northern Territory ..	×*	×*	×*
,, *occultus*, n. sp. ..	Northern Territory ..	×*	..	..

* Described in this paper. † Type or co-types examined.

Mirotermes krisiformis (Froggatt).

Proc. Linn. Soc. N.S.W., Vol. xxii, 1897; Dept. Agric. N.S.W., Bull. 60, 1915. Holmgren, Kungl. sv. vet. Akad. Handl., Bd. 48, No. 4, 192 (Sub-genus *Protocapritermes*).

Plate III., figs. 103, 104; Plate VI., fig. 200; Plate IX., fig. 201.

The antennae are described as being composed of fourteen joints in both imago and soldier, but in a series of imagos from Campbelltown, New South Wales (Froggatt's collection), the number is invariably fifteen.

Locality.—New South Wales.

Mirotermes kraepelini Silvestri.

Die Fauna Südwest Australiens, Bd. ii., Lief 17, 1909. Holmgren, Neu-Guinea Termiten, 1911; Kungl. sv. vet. Akad. Handl., Bd. 48, No. 4, 1912. Mjöberg, Arkiv. för Zoologi, Vol. xii, No. 15, 1920.

Plate III., figs. 105–113; Plate VI., fig. 202; Plate IX., fig. 203.

Considerable difficulty has been experienced in determining the status of numerous series of *Mirotermes* from South-west Australia owing to the variations found in both soldiers and imagos from different colonies. Practically no variation has been observed in imagos from the same colony, and such differences as have been detected in individuals from different colonies, though constant, are by no means marked. In the soldier caste also there is remarkable agreement amongst individuals from the same colony, but variations do occur occasionally (e.g., a specimen with smaller head, shorter and stouter frontal process and narrower gula). Between individuals from different colonies, however, there is often a very marked difference, which, in the absence of imagos, might very reasonably be regarded as specific. Mr. Clark, to whom I am indebted for the material under discussion, on being apprised of the difficulty, kindly made a special effort to obtain further series, with the result that about 45 colonies have been placed at my disposal, of which number about twenty include alate imagos or queens. The balance comprise soldiers and workers, or soldiers only, associated in most cases with species belonging to other genera—*Hamitermes obeuntis* Silv., *Hamitermes* sp., *Leucotermes clarki* Hill, *L. occiduus*, n. sp., and *Eutermes apiocephalus* Silv.—and including several varieties or races more or less distinct (in the soldier caste) from those of which the imagos are known. In view of the fact that only slight differences have been observed in series of imagos the respective soldiers of which are more or less markedly distinct, it has been considered advisable for the present to regard the whole group as being referable to a single species (*M. kraepelini* Silv.) and to briefly describe the more important varieties or races without designating them by

varietal names. A similar course might have been adopted in dealing with certain of the North Australian forms, but in the latter, in the absence of alate imagos, there is nothing in the material at present available for study to suggest specific relationship between the specimens proposed as new, and for this reason they have been given specific rank.

M. kraepelini Silv. was described from soldiers and workers only from Mundaring, South-west Australia. Professor Silvestri has kindly compared examples of these castes from the type locality with the type series and these in turn have been compared with other series (also from the type locality) comprising alate imagos, one of which has been selected and described below as the typical form invariably associated with soldiers of the variety or race described by Silvestri.

Imago.

Colour.—Head, posterior margin of thoracic nota and base of veins very dark brown; postclypeus and remainder of thoracic nota Dresden to mummy brown; labrum pale orange yellow; antennae and pleural sclerites mummy brown; legs Dresden brown more or less darkly suffused with mummy brown; wings dark fuscous with slight iridescence in some lights.

Head (Fig. 105).—Rather small, hemispherical behind the eyes, very setaceous. Postclypeus strongly convex, hemispherical behind, truncate in front, about half as long as wide, with distinct median suture; anteclypeus short, slightly produced in the middle. Labrum wide at the base, widest at the posterior third, broadly rounded in front. Fontanelle elongate, obscurely forked anteriorly. Eyes large ($0{\cdot}238 \times 0{\cdot}255$) and prominent, separated from the lower margin of the head by a space equal to the short diameter of ocelli. Ocelli large ($0{\cdot}068 \times 0{\cdot}102$), about half their short diameter from the eyes. Mandibles (Fig. 106) with the apical tooth not markedly longer than the following one. Antennae (Fig. 107) 15-jointed; 1st joint large, about twice as long and one-fifth wider than 2nd; 3rd very small; 4th markedly larger than 3rd; 5th smaller than 4th but larger than 3rd; 6th to 14th increasing in length progressively; 15th about as long as 1st, pointed at the apex.

Thorax (Fig. 108).—Pronotum very setaceous, a little narrower than head, concave in front, extreme anterior margin elevated, anterolateral angles rounded to the broad posterior margin, which is markedly sinuate; posterior margin of meso- and metanotum deeply emarginate.

Wings (Figs. 202, 203).—Large, costal margin pale yellow in alcohol specimens; radius markedly setaceous; radial sector setaceous throughout, suffused with dark brown posteriorly; media running through the anterior third of wing, generally simple but

frequently branched, often with one or more superior branches towards the radial sector from the proximal third; cubitus with eight to thirteen branches, generally simple, the first six to eight very dark. Membrane densely covered with micrasters and markedly more setaceous on forewing than on hindwing.

Legs.—Moderately long and slender.

Abdomen.—Very setaceous; cerci short and stout.

Measurements.—

	mm.
Length with wings	11·00
,, without wings	5·25–5·50
Head, posterior margin to apex of labrum, long	0·91–1·00
,, posterior margin to clypeofrontal suture, long	0·65
,, wide	0·90
Pronotum, long	0·45
,, wide	0·74
Wings, long	9·50
,, wide	2·40–2·50
Tibia iii, long	1·00

Soldier.

Measurements.—

	mm.
Head, base to apex of frontal process, long	1·48–1·71
,, wide	0·97–1·08
,, deep	0·74–0·85
Gula, at narrowest part, wide	0·17

Locality.—South-west Australia: Mundaring, Gosnells, Armadale, Ludlow, Collie, Lion Mill, Hovea, Wongong.

Twenty-five nest-series examined.

Type imago and associated soldiers and workers in the National Museum of Victoria.

Variety "A."

Soldier.—Agrees with the typical form in having long-jointed antennae and truncate labrum, but differs in having markedly more slender mandibles and wider gula, and, generally, shorter, narrower and shallower head.

Measurements.—

	mm.
Head, to apex of frontal process, long	1·48
,, wide	0·85
,, deep	0·68–0·74
,, with mandibles, long	2·62
Gula, at narrowest paat, wide	0·25

Five nest-series (without imagos) from Mundaring.

Variety "B."

Soldier.—Agrees with Variety "E" excepting in size of head.

Measurements.—

	mm.
Head, to apex of frontal process, long ..	1·30
,, wide	0·90
Gula, at narrowest part, wide	0·20

Three nest-series (without imagos) from near Perth.

Variety "C."

Imago.—As in Variety "E."

Soldier.—Agrees with Variety "E" in having very slender mandibles, but differs in having a wider head and much wider gula, labrum not deeply notched anteriorly but truncate except at antero-lateral corners which are produced into short, fine points, frontal process shorter and thicker at base.

Measurements.—

	mm.
Head, to apex of frontal process, long ..	1·59
,, wide	1·14
,, deep	0·85–0·91
Gula, at narrowest part, wide	0·25

One nest-series from Denmark (taken in January).

Variety "D."

Soldier (Figs. 111, 112).—Agrees with the typical form in having stout mandibles, but differs in having a noticeably larger head, wider, spreading and deeply-notched labrum, relatively much narrower gula and stouter frontal process.

Measurements.—

	mm.
Head, to apex of frontal process, long ..	1·99–2·16
,, wide	1·14–1·24
,, deep	0·97–1·02
Gula, at narrowest part, wide	0·13

One nest-series (without imagos) from Dwellingup.

Variety "E."

Imago.—Differs from the typical form in having the postelypeus and antennae paler, fontanelle slit-like, eyes generally smaller but sometimes as large, i.e., 0·221 × 0·238 to 0·238 × 0·255.

Soldier (Fig. 113).—Differs markedly from the typical form in having the mandibles more slender, labrum deeply notched, wider gula, generally narrower head and shorter jointed antennae.

Measurements.—	mm.
Head, to apex of frontal process, long ..	1·53 1·70 (rarely)
,, with mandibles, long	2·85 2·96
,, wide	0·96–1·00 (rarely)
,, deep	0·80 0·85
Gula, at narrowest part, wide ..	0·20 0·17 (rarely)

Fifteen nest-series from Albany and Bunbury.

Mirotermes melvillensis (Hill).

Proc. Linn. Soc. N.S.W., Vol. xl, 1915.

Plate III., figs. 114–119; Plate VI., fig. 204; Plate IX., fig. 205; Plate VII., figs. 221, 222.

Imago.

Colour.—Head and dorsum of thorax auburn; postclypeus and abdominal tergites argus brown; under surface, legs and antennae clay colour, sternites of abdomen suffused laterally with Brussels brown; wing membrane a little lighter.

Head (Fig. 114). Moderately setaceous, broadly rounded behind, flat on summit. Eyes large (0·204 diameter), prominent, coarsely facetted, separated from the lower margin of head by a space equal to one-third their diameter. Ocelli large, broadly oval, close to eyes. Postclypeus moderately convex, half as long as wide, markedly convex behind, truncate in front. Labrum narrow at base, widest in the middle. Fontanelle long and narrow, situated midway between the base of head and clypeofrontal suture. Antennae 14-jointed: 3rd joint smallest of all; 4th and 5th equal.

Thorax (Fig. 115).- Pronotum a little narrower than head, slightly concave and bent up in front, anterolateral angles broadly rounded, sides sloping to the rounded posterior margin, the surface densely setaceous, the setae on the margins longest, golden. Meso- and metanotum deeply emarginate posteriorly, clothed as in pronotum.

Wings (Figs. 204, 205).—Wing margin very setaceous except on proximal one-third of hind border; radial sector very stout, well separated from radius, setaceous throughout its length; the base of the media and the first five or six branches of cubitus distinct, but all discernible to their extremity. Wing membrane densely covered with micrasters and bearing numerous setae.

Legs.—Moderately stout, very setaceous.

Abdomen.—Nearly parallel on the sides, apex pointed, clothed densely with short, pale setae; cerci short and stout.

Measurements.—	mm.
Length with wings	7·50–8·00
,, without wings	4·00–4·25
Head, from base to clypeofrontal suture, long ..	0·44
,, to apex of labrum, long	0·88
,, at and including eyes, wide	0·76
Wings, forewings, long	6 50
,, ,, wide	1·76
,, hindwings, long	6·25
,, ,, wide	1·82
Pronotum, long	0·42
,, wide	0·68
Tibia iii, long	0·73
Abdomen, wide	1·08

Queen.

Total length, 17 mm.

Soldier.

The following figures and measurements (from type) are supplementary to the original description :—

Measurements—	mm.
Head, to apex of frontal process, long	1·42
,, wide	0·80
,, deep	0·68
Pronotum, long	0·20
,, wide	0·49
Antennae, long	1·82
Tibia iii, long	0·68

Locality.—Northern Territory : Melville Island (type locality for soldier and worker), Stapleton (G.F.H., 4.11.14, type locality for imago), Bathurst Island, Darwin, Koolpinyah, and other localities within 70 miles of Darwin on Darwin–Pine Creek railway.

Biology.—The termitaria vary a good deal in size and shape, but are invariably built on or around a stump (Figs. 221, 222) or over a large surface root ; in the latter case the mass is conical or hemispherical, with a maximum diameter of about 20 inches. The material used in their construction is a black or dark grey composition of earth and vegetable matter. The nymphs pass through their final moult about the middle of October and are capable of flight early in November. Apterous or brachypterous kings and queens have not been found. This species is not of much importance as a pest owing to its rarity, but there are instances of it having done considerable damage to fence-posts and house-blocks. It has not been found in the mounds of other termites.

Affinities.—A very closely related species occurs on Magnetic Island, N.Q. (G.F.H., 9.7.21), and near Torrens Creek, N.Q. (G. F. Cook, 4.2.22), and another at Koolpinyah, N.T. (G.F.H., 20.4.16). All three colonies were found under logs and comprise soldiers and workers only. Descriptions of these species are withheld until further material is to hand.

Types (imago, soldier and worker) in the National Museum of Victoria.

Mirotermes taylori (Hill).

Proc. Linn. Soc. N.S.W., Vol. xl, 1915.

Plate IV., fig. 120.

Soldier.

The following additional measurements are from a soldier from the type colony : —

Measurements.—	mm.
Head, to apex of frontal process, long	1·14
,, wide	0·62
,, deep	0·51
Pronotum, long	0·17
,, wide	0·42
Tibia iii, long	0·48

Locality.—Northern Territory : Koolpinyah.

Mirotermes froggatti (Hill).

Proc. Linn. Soc. N.S.W., Vol. xl, 1915.

Plate IV., fig. 121.

Soldier.

The following additional measurements are from a soldier from the type colony :—

Measurements.—	mm.
Head, to apex of frontal process, long	1·15
,, wide	0·90
Pronotum, long	0·23
,, wide	0·47
Tibia iii, long	0·78

The queen is described as having 13-jointed antennae ; the correct number cannot be stated, as the terminal joint is wanting in the type (unique).

Locality. Northern Territory : Darwin.

MIROTERMES HARRISI Mjöberg.

Arkiv. för Zoologi, Vol. xii, No. 15, 1920.

Locality.—North Queensland.

MIROTERMES MAIDENI Mjöberg.

Arkiv. för Zoologi, Vol. xii, No. 15, 1920.

Locality.—North Queensland.

MIROTERMES CHEELI Mjöberg.

Arkiv. för Zoologi, Vol. xii, No. 15, 1920.

Plate IV., figs, 122 124; Plate VI., fig. 206; Plate IX., fig. 207.

IMAGO.

Colour.—Head, thorax and dorsum of abdomen dark chestnut; postclypeus lighter than head but darker than antennae, legs and under surface; anteclypeus hyaline; wings fuscous, veins dark and distinct to their extremity.

Head (Fig. 122).—Small, hemispherical behind the eyes, very setaceous. Fontanelle elongate, narrowed anteriorly, in line with the middle of the eyes. Antennae (Fig. 123) 15-jointed, the 3rd joint shortest and narrowest, 4th equal to or a little longer than 5th. Postclypeus small, hemispherical behind, with indistinct suture. Eyes large (0·250 diameter), prominent, situated as far above the lower margin of the head as their inner margins are from the ocelli. Ocelli large, oval, one-third longer than wide, separated from the eyes by a space equal to one-half their width.

Thorax (Fig. 124).—Large, nearly as wide as head, very setaceous, concave in front, anterolateral angles broadly rounded, posterior margin slightly sinuate. Posterior margin of meso- and metanotum deeply emarginate.

Wings (Figs. 206, 207).—Small, slender; radial sector and margin (excepting proximal one-third of posterior margin) very setaceous; forewing with twelve, the hindwing with nine branches from the cubitus, the eighth in forewing and seventh and eighth in hindwing generally forked. Membrane densely covered with micrasters and with few setae.

Measurements.—

	mm.
Length with wings	8·00–8·50
,, without wings	4·25–4·50
Head, base to clypeofrontal suture, long ..	0·65
,, base to apex of labrum, long	1·08
,, at and including eyes, wide	0·85–0·88

Measurements.—	mm.
Antennae, long	1·50
Wings, forewings, long	7·00
,, ,, wide	1·97
,, hindwings, long	6·50
,, ,, wide	2·06
Pronotum, long	0·47–0·51
,, wide	0·74–0·80

Locality.—North Queensland: Rollingstone (G.F.H., 21.2.21), all castes; Mareeba (G.F.H., 23.5.21), soldiers and workers: Meringa (F. H. Taylor, 9–19.12.24), all castes; Sonth Johnston (F.H.T., 9.11.24), soldiers and workers.

Identification.—In response to a request to compare the Rollingstone specimens with the type imago (a queen) Professor Sjöstedt very kindly pointed out certain differences and, at the same time, forwarded both the type series and a variety from Laura for examination. Compared with my specimens the type imago is somewhat narrower across the head, has eyes ·01 smaller in diameter and has the pronotum slightly shorter and more narrowed posteriorly, but all of these differences are within the range of variation found in the long series of individuals examined. The soldiers agree more closely with the Laura specimens than with the typical form, but the latter occurs also at Meringa with imagos which appear to be quite typical. In the description the thorax of the type imago is stated to be 0·29 long; this is evidently a typographical error, the actual length being 0·44.

Biology.—The termitaria are built, as Mjöberg states, on the base of a tree-trunk or direct on the ground, the nest illustrated by him being typical of many found in the vicinity of Rollingstone. One isolated nest measured 2 feet in height by 2 ft. 6 in. through its long axis (north and south) by 1 ft. 3 in. through its short axis, thus it resembled in form some of the nests of *Hamitermes wilsoni* Hill described in an earlier paper (Hill, 1922). There is no well-defined division between the hard, blackish outer wall and the more woody interior, such as exists in the nests of *Coptotermes spp.*, but the formation of the middle portion is not unlike that found in the nests of the latter group, although the design is not nearly so bold. When opened on 21st February the nest contained an immense number of eggs and young in all stages of development, but alate imagos were not plentiful, and it appeared that the main colonizing flight had taken place some days earlier during or following heavy falls of rain. The soldiers are pugnacious and, like most of their congeners, crepitate when alarmed. As is well known in other species of this genus this action is followed instantly by a spring backwards or

sideways which carries the insect a distance of $\frac{3}{4}$ inch to (in this species) 2 inches.

Examples from the above-mentioned series are in the National Museum of Victoria.

MIROTERMES ALLENI Mjöberg.

Arkiv. för Zoologi, Vol. xii, No. 15, 1920.

Locality.—North Queensland.

MIROTERMES BROOMENSIS Mjöberg.

Arkiv. för Zoologi, Vol. xii, No. 15, 1920.

Locality.—North-west Australia.

MIROTERMES ALICENSIS Mjöberg.

Arkiv. för Zoologi, Vol. xii, No. 15, 1920.

Locality.—North Queensland.

MIROTERMES SEPTENTRIONALIS, n. sp.

Plate IV., figs. 125–127.

SOLDIER.

Colour.—Head and antennae orange rufous, labrum yellow ochre, thorax and legs cream buff, remainder of insect whitish.

Head (Figs. 125, 126).—Large, parallel on the sides, truncate behind; frontal process short and wide, without lateral processes; antennal carinae large and heavily chitinized. Antennae (Fig. 127) 14-jointed, 2nd joint a little longer and much narrower than 3rd; 3rd longer and wider than 4th, shortest of all; 5th and 6th equal. Labrum very long and wide, spreading markedly to the deeply notched apex. Gula narrow, 0·228–0·255 at its narrowest part.

Thorax. Pronotum narrowed and sharply bent up in front, anterior margin rounded and slightly emarginate, anterolateral angles bluntly rounded, posterior margin rounded and emarginate as in anterior border, the entire margin with a scanty fringe of short and moderately stout setae.

Legs.—Moderately short and stout, with few setae.

Abdomen.—Elongate, widest in the middle, pointed towards the apex, with scanty long and short pale reddish setae; cerci large.

Measurements.—	mm.
Head, to apex of frontal process, long	1·83
Thorax and abdomen, long	3·19
Head, wide	1·36
,, deep	0·94
Pronotum, long	0·42
,, wide	0·84
Tibia iii, long	1·00

Locality.—Northern Territory: Darwin, G.F.H., 24.1.17 (type locality), Stapleton, G.F.H., 1.5.13 (two series).

Affinities.—Closely allied to *M. orbus*, n. sp., *M. quadratus*, n. sp., *M. maideni* Mjöb., and *M. broomensis* Mjöb., from all of which it is distinguished by differences in the frontal process, labrum, antennae and contour of the head.

Biology.—The type series was collected from a dilapidated termitarium of *Eutermes pastinator* Hill from which the original occupants had disappeared. The same nest was also occupied by a colony of each of the following species:– *Mirotermes sunteri* n. sp., *Rhinotermes sp.*, and *Eutermes sp.* The Stapleton series were found in the old termitarium of *Eutermes palmerstoni* Hill described and illustrated in an earlier paper (P.L.S., N.S.W., xl, 1915, p. 93, pl. 17 and 18) in association with *Coptotermes acinaciformis* (Frogg.) and *Eutermes sp.*

Type in the National Museum of Victoria.

Mirotermes infrequens, n. sp.

Plate IV., figs. 128–131; Plate VI., fig. 208; Plate IX., fig. 209.

Imago.

Colour.—Head dark bay, clypeus much lighter; mouth parts, antennae and legs snuff brown; coxae, pleura and sternites of abdomen darker; pronotum and tergites of abdomen a little lighter than head (auburn); wings light fuscous.

Head.—Very setaceous, like thorax and abdomen; short and wide, broadly rounded behind, narrowed sharply between the eyes and posterolateral angles of clypeus, a large hairless area of paler colour than remainder of head in the anterolateral angles between ocelli and posterolateral angles of clypeus. Eyes relatively large (0·187 × 0·187) and very prominent, close to lower margin of head (0·050). Ocelli large, oval, twice as long as wide (0·034 × 0·068), oblique, about half their width from eyes. Postclypeus twice as wide as long (0·170 × 0·340), markedly convex, hemispherical behind, truncate in front, with a distinct dark brown median suture. Anteclypeus large, half as long as postclypeus, sides short and expanding anteriorly, anterior margin obtusely angulate. Labrum

moderately large, narrowed at the base, widest in the middle, broadly rounded in front, yellow, with numerous setae. Antennae (Fig. 129) 14-jointed; 1st joint large, nearly twice as long as wide; 2nd half as long as 1st; 3rd shorter than 5th; 4th shorter and narrower than 3rd; 6th to 14th very long; 3rd rarely shorter than 4th. Fontanelle linear, nearly as long as postclypeus, very narrow.

Thorax (Fig. 128).—Pronotum nearly truncate in front, with the extreme margin slightly raised, sides rounded, posterior margin broadly rounded and without emargination. Posterior margin of meso- and metanotum deeply and acutely notched.

Wings (Figs. 208, 209).—Radius and radical sector dark brown; only base of media dark, remainder very indistinct but discernible to its extremity by a row of minute setae along its course; cubitus with about nine branches in the forewing and from nine to twelve in the hindwing, all but the six or seven proximal ones very indistinct. Membrane with numerous minute setae, chiefly on veins, and densely covered with microsters. Fore and hindwings of about equal size.

Legs.—Slender; claws long and slender.

Abdomen. Short, parallel on the sides, bluntly pointed at the apex; cerci small.

Measurements.	mm.
Length with wings	7·50
,, without wings	4·00
Head, to apex of labrum, long	0·86
,, to clypeofrontal suture, long	0·52
,, wide	0·76
Pronotum, long	0·34
,, wide	0·59
Wings, long	6·40
,, wide	1·70
Tibia iii, long	0·74
Abdomen, wide	0·85

Queen.

Total length, 6·50 mm.; abdomen, wide, 1·40 mm.

Soldier.

Colour.—Head raw sienna, clypeus and frons Sanford's brown; labrum hyaline with ochraceous area in middle.

Head (Fig. 130).—Shagreened, with scattered setae above and on sides, more numerous on frons and especially near fontanelle; short and wide, truncate in front, widest behind antennal fossae, slightly narrowed posteriorly to the nearly truncate hind margin; frontal process dark, very small, hardly projecting beyond the frons;

fontanelle situated midway between clypeofrontal suture and frontal process. Labrum with anterolateral angles produced into acute points. Antennae (Fig. 131) 14-jointed ; 1st long and stout, rather more than half as wide as long ; 2nd as long as 1st is wide, narrowest at base ; 3rd one-fifth shorter than 2nd, widest in middle ; 4th shortest and narrowest of all ; 5th a little longer and wider than 3rd ; 6th to 14th progressively longer ; 14th as long as 1st, one-third as wide as long. Clypeus nearly quadrate ; anteclypeus whitish, rounded in front : frons concave, shagreened, rugose.

Thorax.—Pronotum very small, less than half as wide as head, sharply bent up in front, anterolateral angles prominent, sides sloping to the slightly emarginate rounded posterior margin, entire margin with scanty fringe of moderately stout reddish setae.

Legs.—Moderately stout, with few setae.

Abdomen.—Elongate-oval, pointed towards the apex, widest in middle, with scanty long and short setae.

Measurements.—

	mm.
Total length	3·29
Head, to apex of frontal process, long	1·08
,, at widest part, wide	0·87
,, at narrowest part, wide	0·75
Pronotum, long	0·23
,, wide	0·40
Tibia iii, long	0·56

Worker.

Colour.—Head, thorax, legs and antennae straw yellow.

Head.—Slightly longer than wide, posterior half hemispherical, antennal fossae large, frons flattened, clothed with moderately large reddish setae ; postclypeus large, markedly convex and arcuate behind, twice as wide as long, with scattered reddish setae ; anteclypeus very short and broad, anterior margin obtusely angulate. Antennae 14-jointed ; 4th joint shortest, about half as long as 3rd.

Thorax.—Pronotum two-thirds the width of head, similar in shape to that of soldier, with scanty reddish setae as on meso- and metanotum.

Abdomen.—Elongate-oval, widest in the middle, tapered to the pointed apex.

Locality.—South-west Australia : Wongong (type locality), Ludlow, Armadale. Collected by Mr. J. Clark.

Affinities.—The small size of the imago and the shape of the head of the soldier distinguish this from any other known Australian species.

Types (imago, soldier and worker) in National Museum of Victoria.

Mirotermes quadratus, n. sp.

Plate IV, fig. 132.

Soldier.

Very closely allied to *M. broomensis* Mjöb., from North-west Australia, a co-type of which I have had for comparison. It differs in having markedly smaller antennal joints, more deeply notched labrum, more prominent and elevated frontal process and more prominent lateral processes (Fig. 132). The head and body measurements are approximately the same. The antennae are 14-jointed; 1st joint very long, narrow at the base, widening towards the apex, where it is half as wide as long; 2nd, 3rd and 4th equal in length, about half as long and wide as 1st; 2nd a little narrower than 3rd and 4th; 5th longer and wider than 4th; 6th to 14th increasing in length progressively; 14th one-third longer than 5th.

Locality. - Northern Territory: Stapleton (G.F.H., 23.12.12).

Described from a single specimen found in a termitarium of *Microcerotermes nervosus*, n. sp., which contained also one soldier of an undescribed species of *Hamitermes* and numerous ants (*Camponotus novae-hollandae* Mayr. and *Euponera lutea* Mayr., var. *clara* Crawley).

Type in the National Museum of Victoria.

Mirotermes sunteri. n. sp.

Plate IV., figs. 133 138; Plate VI., fig. 210; Plate IX., fig. 211; Plate VII., figs. 223, 224.

Imago.

Colour. Head, pronotum and anterior one-third of meso- and metanotum and first three abdominal tergites dark chestnut, remaining tergites shading to antique brown; under surface antique brown, pleura and sixth sternite of abdomen (♀) darkest, the first five sternites buckthorn brown with lateral dark areas. Wings fuscous, as in *M. cheeli* Mjöb.

Head (Fig. 133). Broadly rounded behind, flat on summit, setaceous. Eyes large (0·255 0·272), circular, rather coarsely facetted, not prominent, separated from lower margin of head by a space equal to one-fifth their diameter. Ocelli large, broadly oval, separated from the eyes by a space nearly equal to that separating eyes from lower margin of head. Fontanelle linear. Postclypeus convex, less than twice as wide as long, semicircular behind, truncate in front; anteclypeus short and slightly produced anteriorly. Labrum narrowed at the base, wide in the middle and bluntly pointed in front. Antennae (Fig. 135) 15-jointed; 3rd joint shortest and narrowest; 4th and 5th equal. Mandibles (Fig. 134*a* and *b*) with very long apical tooth.

Thorax (Fig. 136).—Pronotum very large, nearly as wide as head, anterior margin slightly concave and elevated, sides sloping sharply to the rounded posterior margin, which is not emarginate, the margins densely fringed with long pale setae, remainder of surface rather densely clothed with shorter setae. Posterior margin of meso- and metanotum deeply notched.

Wings (Figs. 210, 211).—Similar to those of *M. melvillensis* (Hill); densely covered with micrasters.

Legs.—Moderately short and stout, densely setaceous.

Abdomen.—Nearly parallel on the sides, tapered to the bluntly pointed apex; tergites and sternites densely clothed with long and short setae; sixth sternite in the female very long.

Measurements.—	mm.
Length with wings	9·25–9·50
,, without wings	5·00
Head, to apex of labrum, long	0·98
,, to clypeofrontal suture, long	0·59
,, wide	0·88
Wings, forewings, long	7·50
,, ,, wide	2·00
,, hindwings, long	7·30
,, ,, wide	2·05
Pronotum, long	0·61
,, wide	0·85
Tibia iii, long	0·76
Abdomen, wide	1·12

Soldier.

Very closely allied to *M. alicensis* Mjöb., but differing in the following characters:—Frontal process wider at the base, and processes at the side of it smaller, labrum distinctly narrower, antennal carinae more prominent, mandibles more slender, head (Fig. 137) deeper and of different shape. The antennae (Fig. 138) are similarly segmented.

Measurements.—	mm.
Total length	6·15–6·30
Head, to apex of frontal process, long	1·59–1·71
,, wide	1·02
,, deep	0·80–0·85
Pronotum, long	0·34
,, wide	0·68
Tibia iii, long	0·88

Locality.—Northern Territory: Darwin (type locality) and other localities southward to Stapleton, 70 miles from Darwin.

Thirty-three nest-series examined (collected by G.F.H.), of which number sixteen were from their own termitaria and seventeen from the termitaria of species in other genera.

Biology. Small communities are commonly found in rambling passages in the walls of occupied or abandoned termitaria of other species, in which they find sufficient accommodation until the production of alate forms commences, when they proceed to build for themselves. The result may be a rounded excrescence on the side of the original termitarium or a low dome-shaped mound at the foot of it (see Fig. 224); in either case it is a conspicuous object on account of its dark grey or blackish colour. Isolated mounds are common and are invariably built on a stump or upon the ground overlying a stump, root or log. The termitarium illustrated in Fig. 223 is also a common type and indicates the extent of damage that may be done to fence-posts, house-blocks and other wooden objects. The following field notes refer to this species: (1) 34 miles south-east from Darwin, 14.1.13. Soldiers and workers from an abandoned mound of *Eutermes palmerstoni* Hill, in which was found also a colony of each of the following species: *Hamitermes* (*Drepanotermes*) *septentrionalis* Hill, *Mirotermes melvillensis* (Hill), *Hamitermes sp.* and *Eutermes sp.* (2) Same locality and date. Queen, soldiers and workers from nest resembling *M. melvillensis* (Fig. 222) built over and around hardwood pile supporting sheeting at foot of railway embankment; pile almost completely destroyed; queen in small flattened cell about 30 mm. in diameter by 5 mm. high. (3) Batchelor, 17.3.13. Queen, soldiers and workers from a mound similar to that illustrated by Fig. 223, built around trunk of dead *Eucalyptus* tree in forest; queen in small cell at ground level in centre of mound. (4) Same locality and date. Soldiers and workers from blackish nest on side of dead tree; this and many others in same locality resembled the nest of *M. chæli* illustrated by Mjöberg (1920, Plate 5). (5) 34 miles south-east from Darwin, 27.7.13. Soldiers and workers from a small blackish, rounded mass built on the side of a termitarium of *Eutermes palmerstoni* Hill 30 inches from the ground. (6) Koolpinyah, 21.11.13. Soldiers, workers and first-form nymphs from a mound similar to that illustrated by Fig. 223. The post had been in the ground four years. (7) Darwin, 16.12.13. Alate imagos, soldiers, workers and first-form nymphs from black, earthy mass enveloping the hardwood timbering at entrance to miner's prospecting shaft. *Rhinotermes sp.* were found in the mass and in the adjacent timber. (8) Darwin, 13.11.14. Alate imagos, soldiers and workers from a large termitarium built at the base of a *Melaleuca* tree. The middle of the mass contained a large colony of *Coptotermes acinaciformis* (Frogg.) completely enveloped in a dense covering of black earthy material 12 inches or more in thickness, which contained three distinct colonies of *Mirotermes*, each with a fully developed first-form queen, alate imagos,

soldiers and workers. Other parts of the mass contained a large colony of ants (*Opisthopsis haddoni* Sm. and *Camponotus novaehollandae* Mayr.). (9) Same locality and date. All castes, including alate imagos and a queen, from a termitarium similar to that illustrated by Fig. 224, from the base of a mound of *Eutermes longipennis* Hill. (10) 40 miles west from Stapleton, 2.10.14. Alate imagos, soldiers and workers from a blackish irregularly-shaped mound built over a log lying upon the ground. (11) Darwin, 30.10.14. Soldiers and workers in termitarium of *Microcerotermes nanus* (Hill). (12) Darwin, 5.10.15. Alate imagos, soldiers and workers from a dome-shaped earthy mound 12 inches high on railway embankment; most of the colony in a tree trunk lying 6 inches below the surface. (13) Darwin, 13.10.15. Alate imagos, soldiers and workers from a typical mound built partly on ground and partly on stem of *Macrozamia* plant; the majority of the imagos were seen to leave the colony during heavy rain two days earlier. (14) Darwin, 19.9.16. All castes, including alate imagos, from a parallel-sided, round-topped mound 12 inches high and built over a large root several inches below the surface.

Types (imago and soldier) in the National Museum of Victoria.

Mirotermes banksiensis, n. sp.

Plate IV., figs. 139–143; Plate VI., fig. 212; Plate IX., fig. 213.

Imago.

Colour.—Head and pronotum very dark chestnut; postclypeus and labrum distinctly lighter, a little darker than antennae, legs and mouth-parts; anteclypeus whitish, hyaline; ventral surface same colour as legs, the sternites dark brown laterally; wings dark fuscous.

Head (Fig. 139). Very hairy; fontanelle lanceolate, narrowed anteriorly; antennae (Fig. 141) 15-jointed.

Very closely related to *M. cheeli* Mjöb., from which species it may be distinguished by the following characters: Head more setaceous, postclypeus much lighter; wings smaller, lighter and with different microsters; head and body lighter coloured (more reddish); ocelli larger ($0{\cdot}080 \times 0{\cdot}112$, as against $0{\cdot}064 \times 0{\cdot}080$ in *M. cheeli*); differently shaped thorax (cf. Figs. 124, 140). The relative position of the eyes to the lower margin of the head and of the ocelli to the eyes is about the same in the two species, as is the size of the eyes.

Measurements.—

	mm.
Length with wings	7·00–7·25
,, without wings	3·70–4·25
Head, to apex of labrum, long . ..	1·03
,, wide	0·84

Measurements continued.	mm.
Antennae, long	1·30–1·40
Pronotum, long	0·47
,, wide	0·70
Wings, forewings, long	6·25
,, ,, wide	2·02
,, hindwings, long	6·10
,, ,, wide	2·11
Tibia iii, long	0·94

Soldier.

I am unable to find any characters by which the soldiers of this species can be separated from those of *M. cheeli*. In most examples the third joint of the antennae is markedly longer than the second and fourth (as described in *M. cheeli*), but in some the difference is almost imperceptible, as is the case in one of Mjöberg's specimens. The frontal process is a little less pointed than in the co-type referred to, but the difference is very slight.

Worker.

As in *M. cheeli* Mjöb.

Locality. Islands of Torres Strait.

Described from a complete nest-series collected on Banks Island by Rev. G. A. Luscombe (22.11.20) from a termitarium about 2 feet high. The following additional specimens were received also from the same collector:—A complete nest-series from a blackish, earthy mound built against a tree-trunk, Banks Island (26.11.20); soldiers, workers and young larvae from a similar nest, Badu Island (26.11.21); soldiers, workers and two first-form queens (ovigerous) from a black, earthy termitarium 2 feet long by 1 foot across at the widest part, built near the ground on tree-trunk, Banks Island (27.4.21); (4) soldiers, workers, nymphs and 30 brachypterous queens from termitarium similar to (3), Banks Island (G.A.L., 22.6.21); (5) soldiers, workers and young larvae from interior of dead coconut palm, Banks Island (Dr. G. H. Vernon, September, 1920).

Types (imago, soldier and worker) in the National Museum of Victoria.

Mirotermes orbus, n. sp.

Plate IV., figs. 144–146; Plate VI., fig. 214.

Imago.

Similar to *M. sanderi*, n. sp. in gross appearance and colour of wings, but the dorsal surface is slightly darker and the ventral

surface distinctly darker, eyes much smaller, head larger and more setaceous, postclypeus shorter (0·062 as against 0·074), and pronotum distinctly different (cf. Figs. 136, 144).

Head. Eyes small, prominent, circular (0·221 0·238), close (0·068) to lower margin of head. Ocelli rather small, oval, separated from the eyes by a space equal to their breadth. Antennae 15-jointed. Fontanelle linear. Mandibles apparently as in *M. sunteri*.

Thorax (Fig. 144).—Pronotum concave in front, anterolateral angles rounded, sides rounded to the slightly sinuate posterior margin. Posterior margin of meso- and metanotum deeply emarginate.

Wings (Fig. 214).—Hindwing with radius and radial sector dark; media distinct to the apex of wing, without branches; cubitus joining the margin at apex of wing, with thirteen branches, the first nine distinctly darker than the remainder. Membrane moderately setaceous and densely covered with microsters.

Measurements.—	mm.
Length without wings	5·00
Head, to apex of labrum, long	1·00
,, to clypeofrontal suture, long	0·65
,, wide	0·91
Pronotum, long	0·57
,, wide	0·82
Wings, hindwings, long	8·00
,, ,, wide	2·16
Tibia iii, long	0·85
Abdomen, wide	1·30

Soldier.

Differs from *M. septentrionalis*, n. sp. as follows:—Frontal process much larger (Figs. 145, 146), front of head less receding, labrum smaller and narrowed towards the apex (not widened, as in *M. septentrionalis*), gula narrower (0·170 at narrowest part), antennae with longer and narrower joints, the 2nd joint shorter and narrower than 3rd and 4th, which are equal in length and shortest of all, 3rd as long as 5th but wider, 5th to 14th long and slender, 6th to 13th about equally long, 14th longer and narrower than 13th, pointed.

Worker.

Colour.—Head clay colour, postclypeus light orange yellow.

Head.—Moderately setaceous, the hairs mostly long; widest in line with the insertion of antennae, sloping to the rounded posterior margin. Postclypeus moderately convex, with indistinct median suture, short, about three-eighths as long as wide; anteclypeus small,

anterior margin convex. Antennae 14-jointed: 4th joint shortest, but little shorter than 3rd; 5th noticeably longer than 4th and shorter than 6th; 6th to 14th long and slender.

Thorax. Pronotum much narrower than head; with scattered long, pale hairs, anterior half narrowed and bent up, anterior margin with slight emargination, anterolateral angles produced, the sides and posterior margin together almost hemispherical.

Measurements.	mm.
Total length	4·00–4·75
Head, to apex of labrum, long	0·85–1·19
,, to clypeofrontal suture, long	0·45–0·62
,, wide	0·85–1·08
Pronotum, long	0·28–0·30
,, wide	0·57–0·62
Tibia iii, long	0·85–0·91

Locality. Northern Territory: Stapleton.

Described from two imagos, one soldier and two workers from near the ground in the clayey wall of a termitarium of *Coptotermes acinaciformis* (Frogg.), which was inhabited also by a colony of *Microcerotermes fugax*, n. sp. (C.F.H., 31.12.12).

Types (imago, soldier and worker) in the National Museum of Victoria.

Mirotermes occultus, n. sp.

Plate IV., figs. 147–149; Plate VI., fig. 215.

Imago.

Colour. Head chestnut; postclypeus clay colour; labrum light orange yellow; thorax and abdomen a little lighter than head; under surface, wings and legs ochraceous tawny.

Head (Fig. 147). Small, broadly rounded behind, moderately setaceous, hairs short. Fontanelle long and narrow, obscurely forked anteriorly, its anterior end in line with the middle of the eyes. Eyes relatively large (0·187 × 0·187), prominent, finely facetted. Ocelli large, broadly oval, separated from the eyes by a space equal to their breadth. Postclypeus small, about one-third wider than long (0·204 × 0·306), truncate in front, moderately convex, median suture not very distinct, with scattered, moderately long setae; anteclypeus large, nearly half as long as postclypeus, slightly produced in front. Labrum long and rather narrow, narrow at base, rounded in front. Mandibles (Fig. 148) with the apical tooth markedly longer than the succeeding one. Antennae 14-jointed; 3rd joint very little smaller than 4th; 5th to 13th increasing in size progressively.

Thorax (Fig. 149).—Pronotum wide, nearly as wide as head and similarly clothed; anterior margin slightly sinuate, with extreme edge elevated and with indistinct emargination; sides sloping to the markedly sinuate posterior margin; a deep impression on either side of the median line just behind the upturned anterior border. Posterior margin of meso- and metanotum deeply emarginate.

Wings (Fig. 215).—Wing-stumps covering about two-thirds of their respective nota, base of veins distinct. Wings small; radial sector noticeably darker than other veins; media traversing the wing above the middle and joining the margin at the apex, simple or with two or three branches; cubitus with ten to twelve branches, the first five to eight moderately distinct, all discernible to the border, the last sometimes with one or two branches. Membrane with or without minute setae, generally present on forewing and absent on hindwing; micrasters very small and quite distinct from those of other species.

Legs.—Short and moderately stout, rather densely clothed with long setae; claws long.

Measurements.—	mm.
Length with wings	7·50–8·00
,, without wings	3·70–4·15
Head, to apex of labrum, long	0·80–0·90
,, to clypeofrontal suture, long	0·42–0·47
,, wide	0·68–0·71
Pronotum, long	0·34
,, wide	0·59
Wings, long	6·75
,, wide	1·65–1·76
Tibia iii, long	0·44
Abdomen, wide	0·90

Locality.—Northern Territory: Koolpinyah.

Described from specimens collected on the wing at sundown (G.F.H., 23.11.13). A few specimens of *M. froggatti* (Hill), or a very closely allied species, were associated with them.

Affinities.—Distinguished from *M. taylori* (Hill) by slightly larger eyes, oval ocelli, 14-jointed antennae, much shorter and wider pronotum, and from *M. froggatti* (Hill) by its smaller size, smaller eyes and ocelli and distinctly different pronotum.

Type in the National Museum of Victoria.

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EXPLANATION OF PLATES.

Plate I.

Fig.		
1.	*Calotermes* (*Neotermes*) *papua* Desn.	Imago : head.
2.	,, ,, ,,	Soldier : mandibles.
3.	,, ,, ,,	,, antenna.
4.	,, ,, ,,	,, pronotum.
5.	,, (*Cryptotermes*) *gulosus*, n. sp.	Imago : head, pronotum and posterior margin of meso- and metanotum.
6.	,, ,,	,, antenna, basal joints.
7.	,, ,,	,, antenna, apical joints.
8.	,, ,,	Soldier : head in profile.
9.	,, ,,	,, head from above.
10.	,, ,,	,, pronotum and posterior margin of meso- and metanotum.
11.	,, ,,	,, antenna.
12.	,, (*Cryptotermes*) *primus*, Hill	Imago : pronotum.
13.	,, (*Cryptotermes*) *repentinus*, n. sp.	,, pronotum and posterior margin of meso- and metanotum.
14.	*Coptotermes remotus*, n. sp. . .	Soldier : head.
15.	,, *michaelseni* Silv.	,, ,,
16.	,, *obiratus*, n. sp.	,, ,,
17.	*Rhinotermes umbraticus*, n. sp.	,, ,,
18.	,, ,,	,, pronotum and posterior margin of meso- and metanotum.
19.	*Eutermes rufirostris*, n. sp. . .	,, head in profile.
20.	,, ,, . .	,, head from above.
21.	,, ,, . .	,, antenna.
22.	,, *yandiniensis*, n. sp.	Imago : head.
23.	,, ,,	,, pronotum and posterior margin of meso- and metanotum.
24.	,, ,,	Soldier : head in profile.
25.	,, ,,	,, head from above.
26.	,, ,,	,, antenna.
27.	,, *kuewiengensis*, n. sp.	Imago : head, pronotum and posterior margin of meso- and metanotum.
28.	,, ,,	Soldier : head in profile.
29.	*Microcerotermes biroi* (Desn.)	Imago : pronotum and posterior margin of meso- and metanotum.
30.	,, *umbritarsus*, n. sp.	,, head, pronotum and posterior margin of meso- and metanotum.
31.	,, ,,	,, antenna.
32.	,, ,,	Soldier : head.
33.	,, ,,	,, antenna.
34.	,, *repugnans*, n. sp.	,, head and pronotum.
35.	,, ,,	,, mandibles.
36.	,, ,,	,, antenna.

Plate II.

Fig.				
37.	*Leucotermes paradoxus* (Frogg.)	..	Imago :	head and pronotum.
38.	,, ,,	..	Soldier :	head in profile.
39.	,, ,,	..	,,	head from above.
40.	,, ,,	..	,,	pronotum and posterior margin of mesonotum.
41.	,, *validus* (Hill)	..	Imago :	head.
42.	,,	..	,,	pronotum and posterior margin of meso- and metanotum.
43.	,, ,,	..	Soldier :	antenna.
44.	,, ,,	..	,,	mandible.
45.	,, ,,	..	,,	pronotum.
46.	,, *occiduus*, n. sp.	..	Imago :	head and pronotum.
47.	,, ,,	..	,,	antenna.
48.	,, ,,	..	Soldier :	antenna.
49.	,, *vagus*, n. sp.	..	,,	head.
50.	,, ,,	..	,,	antenna (14-jointed).
51.	,, ,,	..	,,	antenna (13-jointed).
52.	,, *venustus*, n. sp.	..	Imago :	head in profile.
53.	,, ,,	..	,,	antenna.
54.	,, ,,	..	Soldier :	mandible and labrum.
55.	,, ,,	..	,,	palpus.
56.	,, ,,	..	,,	antenna.
57.	*Microcerotermes serratus* (Frogg.)	..	Imago :	antenna.
58.	,, ,,	..	,,	pronotum and posterior margin of meso- and metanotum (two forms).
59.	,, ,,	..	Soldier :	head (Townsville, N.Q.).
60.	,, ,,	..	,,	head (type locality).
61.	,, ,,	..	,,	head (Townsville, N.Q.).
62.	,, ,,	..	,,	gula.
63.	,, ,,	..	,,	antenna.
64.	,, *distinctus* Silv.	..	Imago :	head.
65.	,, ,,	..	,,	pronotum and posterior margin of meso- and metanotum.
66.	,, ,,	..	..	antenna.
67.	,, *nanus* (Hill)	..	,,	head.
68.	,, ,,	..	,,	pronotum and posterior margin of meso- and metanotum.
69.	,, ,,	..	Soldier :	head (showing two forms of antenna).
70.	.. ,,	..	,,	head (var. from Banks Is.).
71.	,, ..	..	,,	gula (var. from Banks Is.).

Plate III.

72.	*Microcerotermes leai*, n. sp.	..	Imago :	head.
73.	,, ,,	..	,,	antenna.
74.	,, ,,	..	,,	pronotum.
75.	,, ,,	..	,,	posterior margin of meso- and metanotum.
76.	,, ,,	..	Soldier :	head.
77.	.. *nervosus*, n. sp.	..	Imago :	antenna.
78.	,, ,,	..	,,	pronotum and posterior margin of meso- and metanotum.

PLATE III.—*continued.*

Fig.				
79.	*Microcerotermes, nervosus*, n. sp.	..	Soldier :	head and pronotum.
80.	,, ,,	..	,,	mandibles and labrum.
81.	,, ,,	..	,,	antenna.
82.	,, *newmani*, n. sp.	..	Imago :	antenna.
83.	,, ,,	..	,,	pronotum and posterior margin of meso- and metanotum.
84.	,, ,,	..	Soldier :	head.
85.	,, *gladius*, n. sp.	..	,,	head, pronotum and gula.
86.	,, ,,	..	,,	antenna.
87.	,, *boreus*, n. sp.	..	,,	head and pronotum.
88.	,, ,,	..	,,	mandibles, labrum and antenna.
89.	,, *fugax*, n. sp.	..	Imago :	head.
90.	,, ,,	..	,,	pronotum.
91.	,, ,,	..	,,	posterior margin of meso- and metanotum (two forms).
92.	,, ,,	..	,,	antenna.
93.	,, ,,	..	Soldier :	head, pronotum and gula.
94.	,, ,,	..	,,	antenna.
95.	,, *taylori*, n. sp.	..	,,	head.
96.	,, ,,	..	,,	gula.
97.	,, ,,	..	,,	antenna.
98.	,, *mendicus*, n. sp.	..	Imago :	pronotum and posterior margin of meso- and metanotum.
99.	,, ,,	..	,,	antenna.
100.	,, ,,	..	,,	mandibles.
101.	,, ,,	..	Soldier :	head.
102.	,, ,,	..	,,	antenna.
103.	*Mirotermes krisiformis* (Frogg.)	..	Imago :	pronotum and posterior margin of meso- and metanotum.
104.	,, ,,	..	,,	mandibles.
105.	,, *kraepelini* Silv.	..	Imago :	head.
106.	,, ,,	..	,,	mandibles.
107.	,, ,,	..	,,	antenna.
108.	,, ,,	..	,,	thorax.
109.	,, ,,	..	Soldier :	head in profile.
110.	,, ,,	..	,,	head viewed obliquely.
111.	,, ,,	..	,,	head, var. "D" viewed obliquely.
112.	,, ,,	..	,,	antenna of var. "D."
113.	,, ,,	..	,,	antenna of var. "E."
114.	,, *melvillensis* (Hill)	..	Imago :	head.
115.	,, ,,	..	,,	pronotum and posterior margin of meso- and metanotum.
116.	,, ,,	..	Soldier :	head in profile.
117.	,, ,,	..	,,	head from above.
118.	,, ,,	..	,,	labrum.
119.	,, ,,	..	,,	antenna.

PLATE IV.

120.	*Mirotermes taylori* (Hill)	..	Soldier :	head.
121.	,, *froggatti* (Hill)	..	,,	head.
122.	,, *cheeli* Mjöb.	..	Imago :	head.
123.	,, ,,	..	,,	antenna.

Plate IV.—*continued.*

Fig.			
124.	*Mirotermes cheeli* Mjöb	..	Imago : pronotum and posterior margin of meso- and metanotum.
125.	,, *septentrionalis*, n. sp.	..	Soldier : head in profile.
126.	,, ,,	..	,, head from above.
127.	,, ,,	..	,, antenna.
128.	,, *infrequens*, n. sp.	..	Imago : thorax.
129.	,, ,,	..	,, antenna.
130.	,, ,,	..	Soldier : head, pronotum and labrum.
131.	,, ,,	..	,, antenna.
132.	,, *quadratus*, n. sp.	..	,, head.
133.	,, *sunteri*, n. sp.	..	Imago : head.
134.	,, ,,	..	,, mandibles ("a" left, "b" right).
135.	,, ,,	..	,, antenna.
136.	,, ,,	..	,, pronotum and posterior margin of meso- and metanotum.
137.	,, ,,	..	Soldier : head.
138.	,, ,,	..	,, antenna.
139.	,, *banksiensis*, n. sp.	..	Imago : head.
140.	,, ,,	..	,, pronotum and posterior margin of meso- and metanotum.
141.	,, ,,	..	,, antenna.
142.	,, ,,	..	Soldier : head viewed obliquely.
143.	,, ,,	..	,, antenna.
144.	,, *orbus*, n. sp.	..	Imago : pronotum and posterior margin of meso- and metanotum.
145.	,, ,,	..	Soldier : head in profile.
146.	,, ,,	..	,, head from above.
147.	,, *occultus*, n. sp.	..	Imago : head.
148.	,, ,,	..	,, mandibles.
149.	,, ,,	..	,, thorax.

Plate V.

150.	*Calotermes* (*Neotermes*) *papua* Desn.	..	..	..	Forewing.
151.	,, (*Cryptotermes*) *gulosus*, n. sp.	..	..	..	,,
153.	,, (*Glyptotermes*) *xantholabrum*, n. sp.			..	Wings.
155.	,, (*Cryptotermes*) *albipes* Holmgr.	..	..	..	Forewing.
157.	*Eutermes yandiniensis*, n. sp.	..	..	..	,,
159.	,, *kaewiengensis*, n. sp.	..	..	..	,,
161.	*Microcerotermes biroi* (Desn.)	..	..	..	,,
163.	,, *umbritarsus*, n. sp.	..	..	..	Wings.
165.	,, *froggatti*, n. sp.	..	..	..	Forewing.
167.	*Leucotermes ferox* (Frogg.)	..	..	..	,,
169.	,, *paradoxus* (Frogg.)	..	..	..	,,
171.	,, *clarki* Hill ..	..	..	..	,,
173.	,, *validus* (Hill) ..	..	..	..	,,
175.	,, *occiduus*, n. sp.	..	..	..	,,
177.	,, *venustus*, n. sp.	..	..	..	,,
179.	*Microcerotermes serratus* (Frogg.)	..	..	..	Wings.
181.	,, *distinctus* Silv.	..	..	..	Forewing.

Plate VI.

Fig.		
183.	*Microcerotermes nanus* (Hill)	Forewing.
186.	,, *leai*, n. sp.	Wings.
188.	,, *nervosus*, n. sp.	Forewing.
190.	,, *newmani*, n. sp.	,,
192.	,, *boreus*, n. sp.	,,
194.	,, *fugax*, n. sp.	,,
196.	,, *taylori*, n. sp.	,,
198.	,, *mendicus*, n. sp.	Wings.
200.	*Mirotermes krisiformis* (Frogg.)	Forewing.
202.	,, *kraepelini* Silv.	,,
204.	,, *melvillensis* (Hill)	,,
206.	,, *cheeli* Mjöb.	,,
208.	,, *infrequens*, n. sp.	,,
210.	,, *sunteri*, n. sp.	,,
212.	,, *banksiensis*, n. sp.	,,
214.	,, *orbus*, n. sp.	Hindwing.
215.	,, *occultus*, n. sp.	Forewing.

Plate VII.

218. Termitarium of *Microcerotermes nervosus*, n. sp.
219. ,, ,, *boreus*, n. sp.
220. ,, ,, *fugax*, n. sp.
221. ,, *Mirotermes melvillensis* (Hill). Bathurst Island, Northern Territory.
222. ,, *Mirotermes melvillensis* (Hill). Darwin, Northern Territory.
223. ,, *Mirotermes sunteri*, n. sp. at base of fence post. Darwin, Northern Territory.
224. ,, *Mirotermes sunteri*, n. sp. partly on ground and partly on wall of termitarium of *Coptotermes acinaciformis* (Frogg.). Stapleton, Northern Territory.

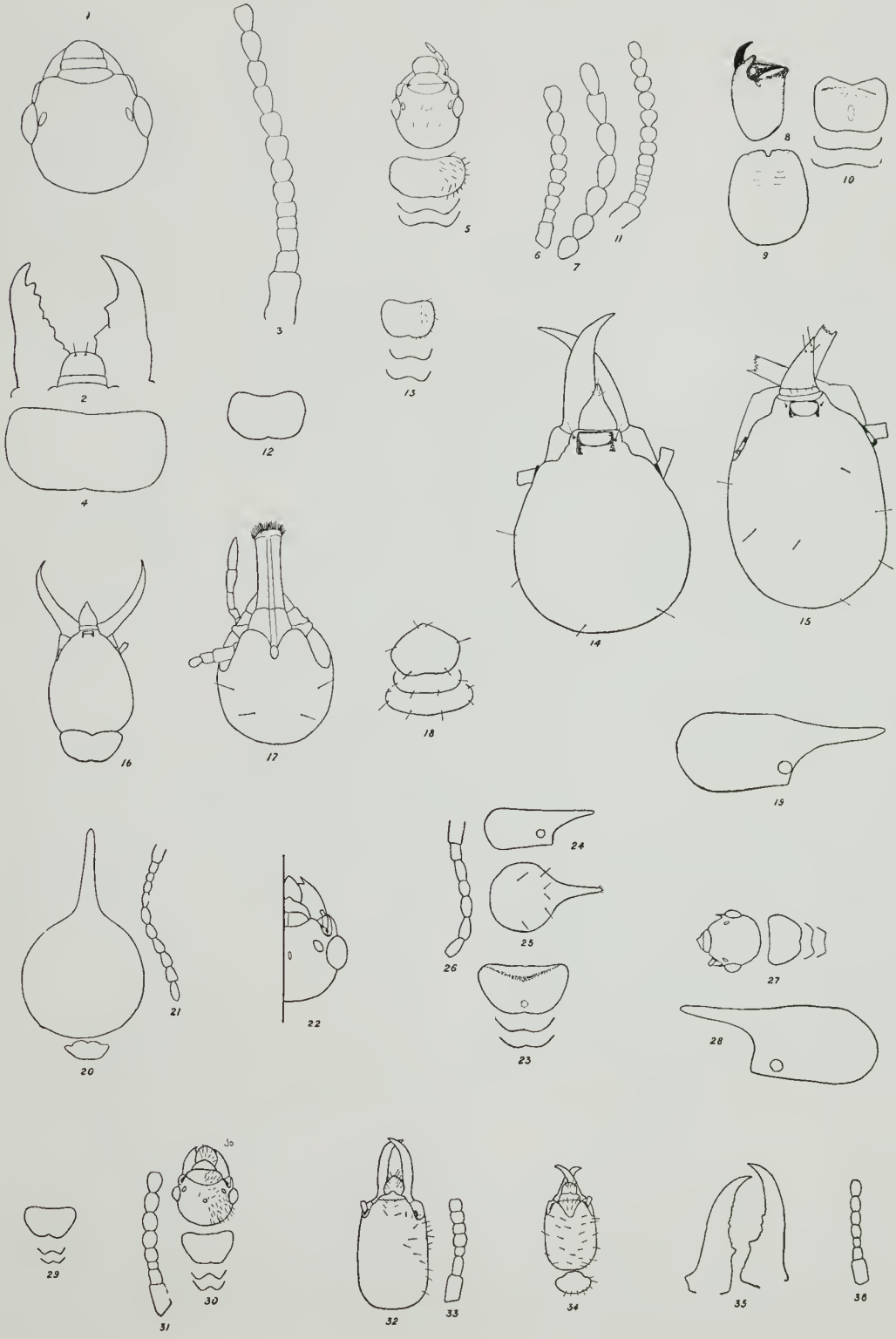
Plate VIII.

152.	*Calotermes* (*Cryptotermes*) *gulosus*, n. sp.	Wing membrane
154.	,, (*Glyptotermes*) *xantholabrum*, n. sp.	,,
156.	,, (*Cryptotermes*) *albipes* Holmgr.	,,
158.	*Entermes yandiniensis*, n. sp.	,,
160.	,, *kaewiengensis*, n. sp.	,,
162.	*Microcerotermes biroi* (Desn.)	,,
164.	,, *umbritarsus*, n. sp.	,,
166.	,, *froggatti*, n. sp.	,,
168.	*Leucotermes ferox* (Frogg.)	,,
170.	,, *paradoxus* (Frogg.)	,,
172.	,, *clarki* (Hill)	,,
174.	,, *validus* (Hill)	,,
176.	,, *occiduus*, n. sp.	,,
178.	,, *venustus*, n. sp.	,,
180.	*Microcerotermes serratus* (Frogg.)	,,
182.	,, *distinctus* Silv	,,

Plate IX.

Fig.

184. *Microcerotermes nanus* (Hill) Wing membrane.
185. ,, *parviceps* Mjöb. ,,
187. ,, *leai*, n. sp. ,,
189. ,, *nervosus*, n. sp. ,,
191. ,, *newmani*, n. sp. ,,
193. ,, *boreus*, n. sp. ,,
195. ,, *fugax*, n. sp. ,,
197. ,, *taylori*, n. sp. ,,
199. ,, *mendicus*, n. sp. ,,
201. *Mirotermes krisiformis* (Frogg.) ,,
203. ,, *kraepelini* Silv. ,,
205. ,, *melvillensis* (Hill) ,,
207. ,, *cheeli* Mjöb ,,
209. ,, *infrequens*, n. sp. ,,
211. ,, *sunteri*, n. sp. ,,
213. ,, *banksiensis*, n. sp. ,,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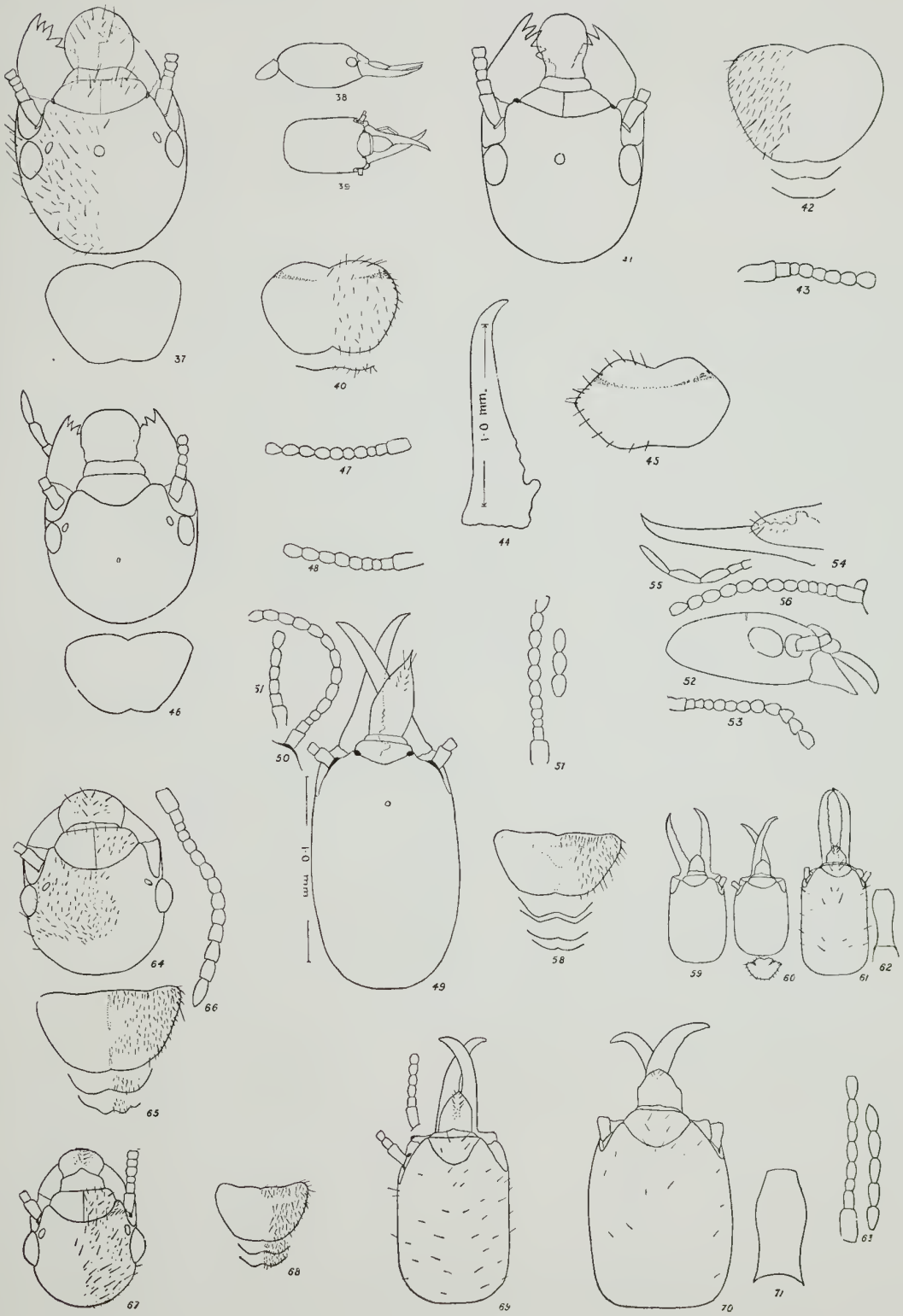
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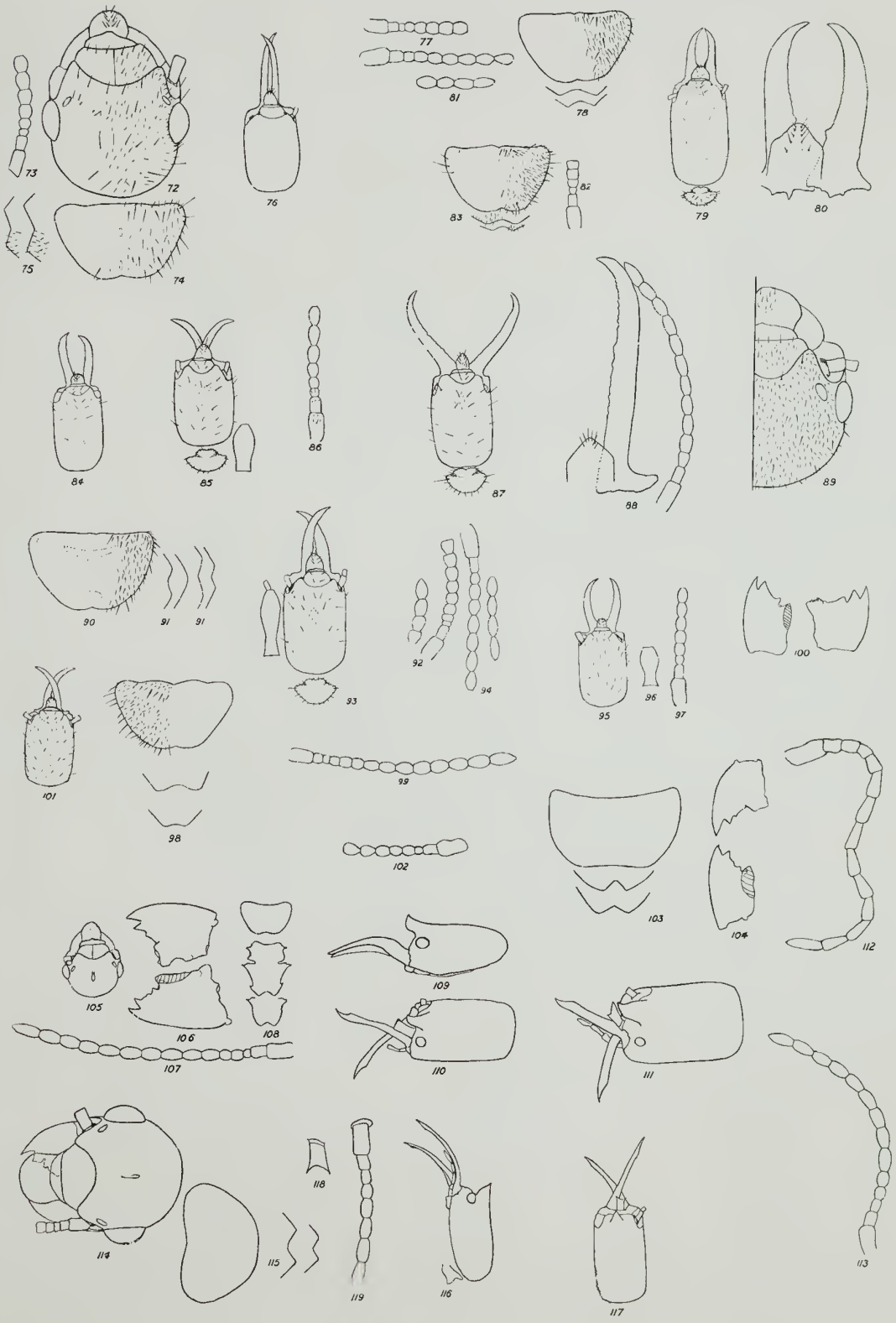
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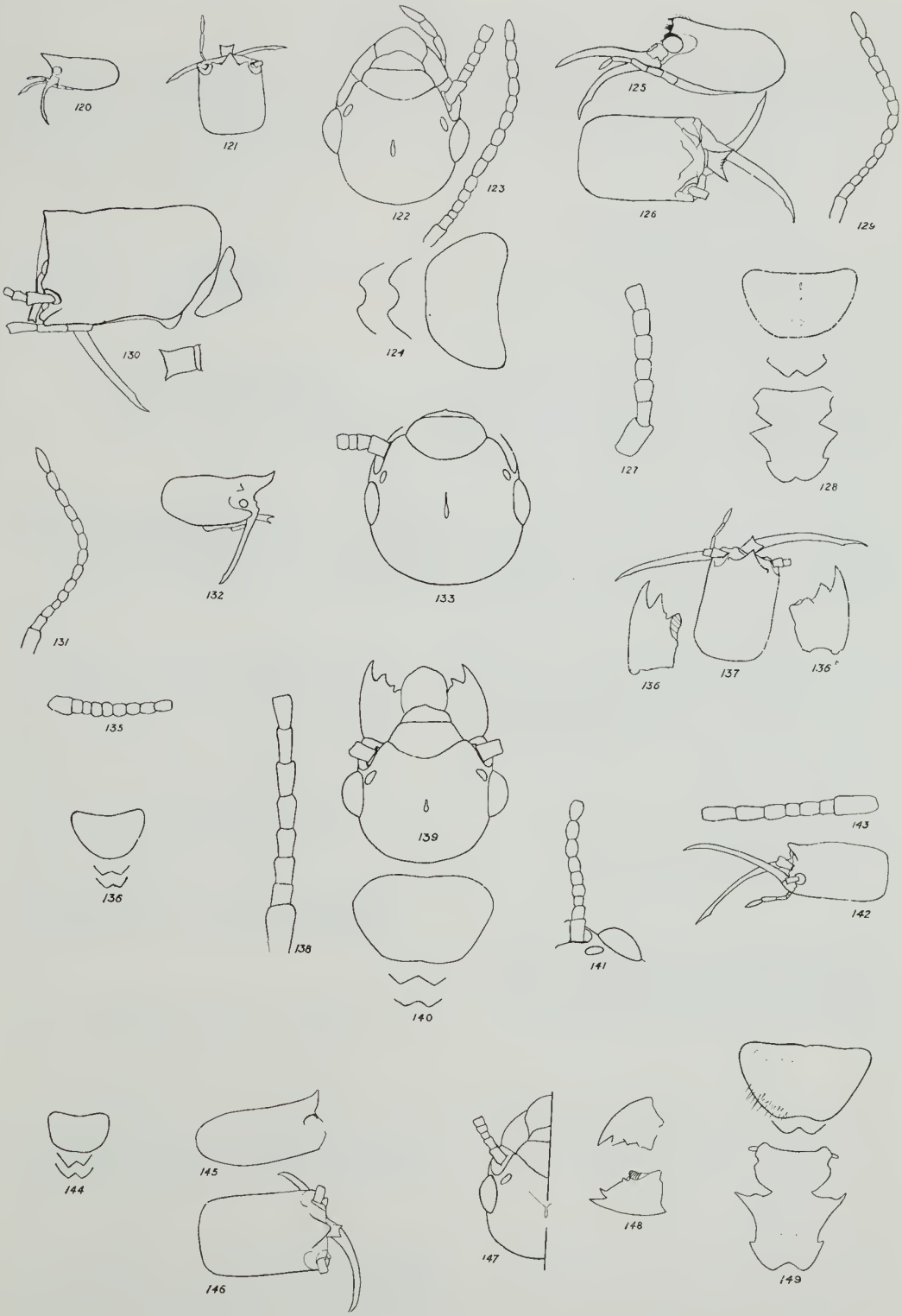
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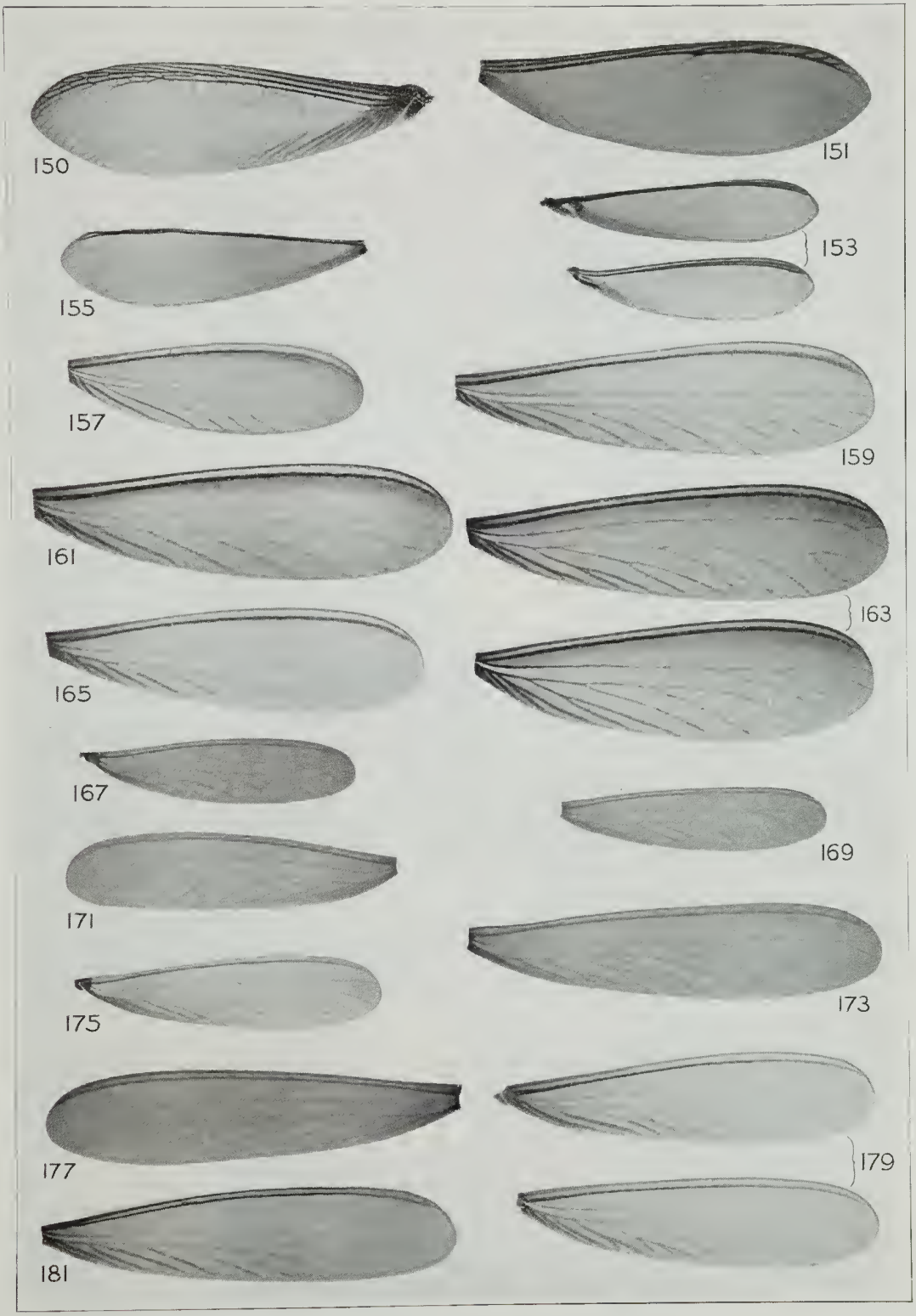
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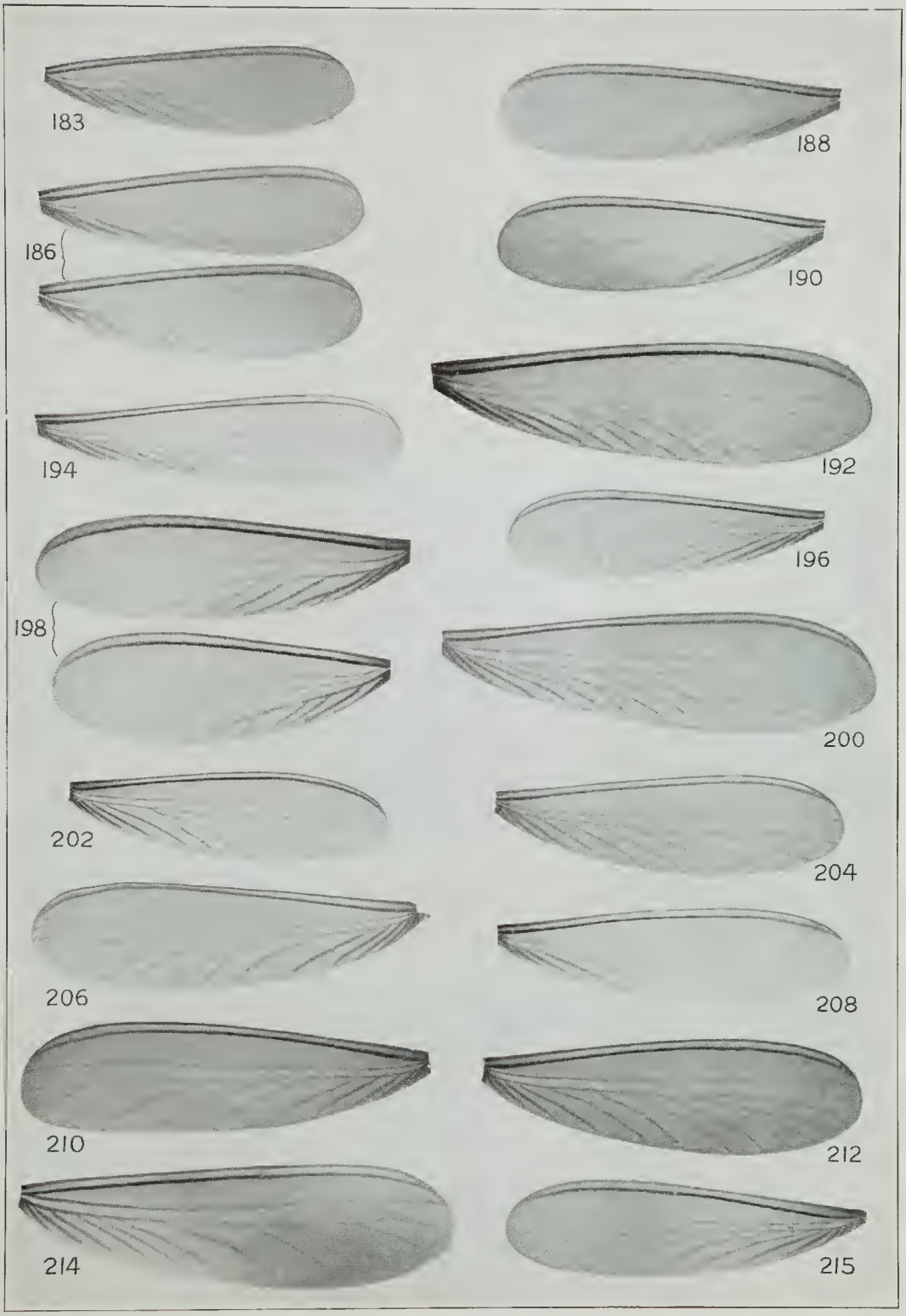
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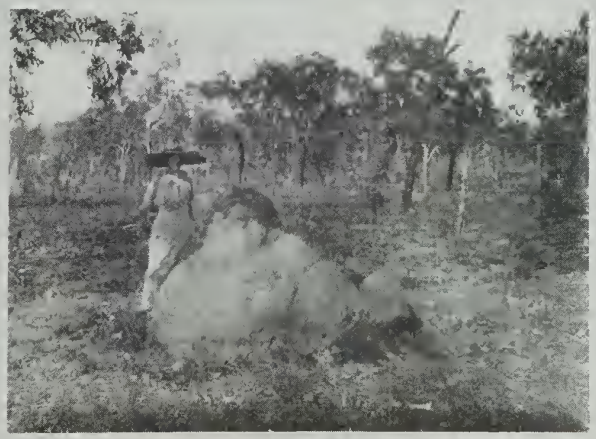

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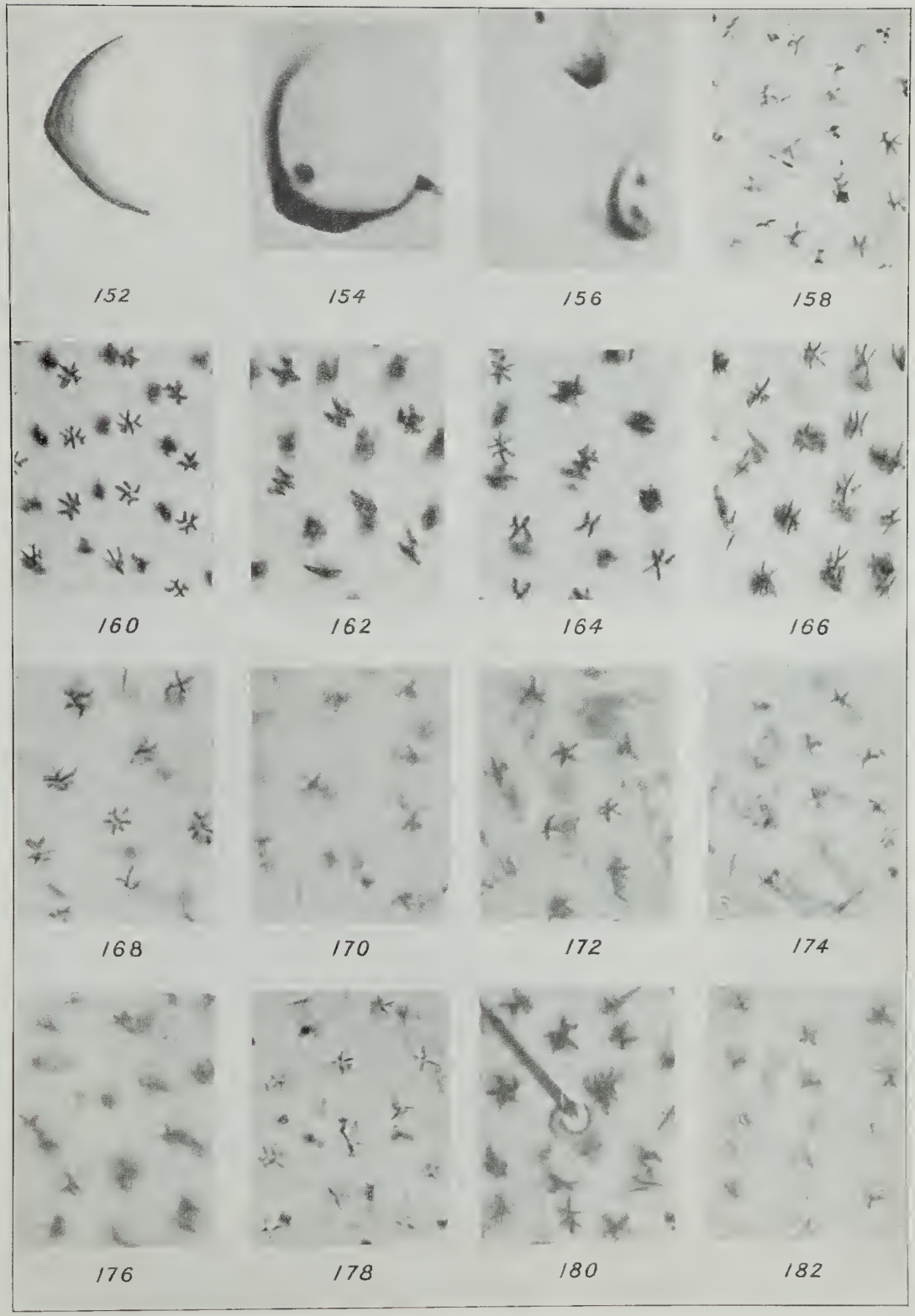
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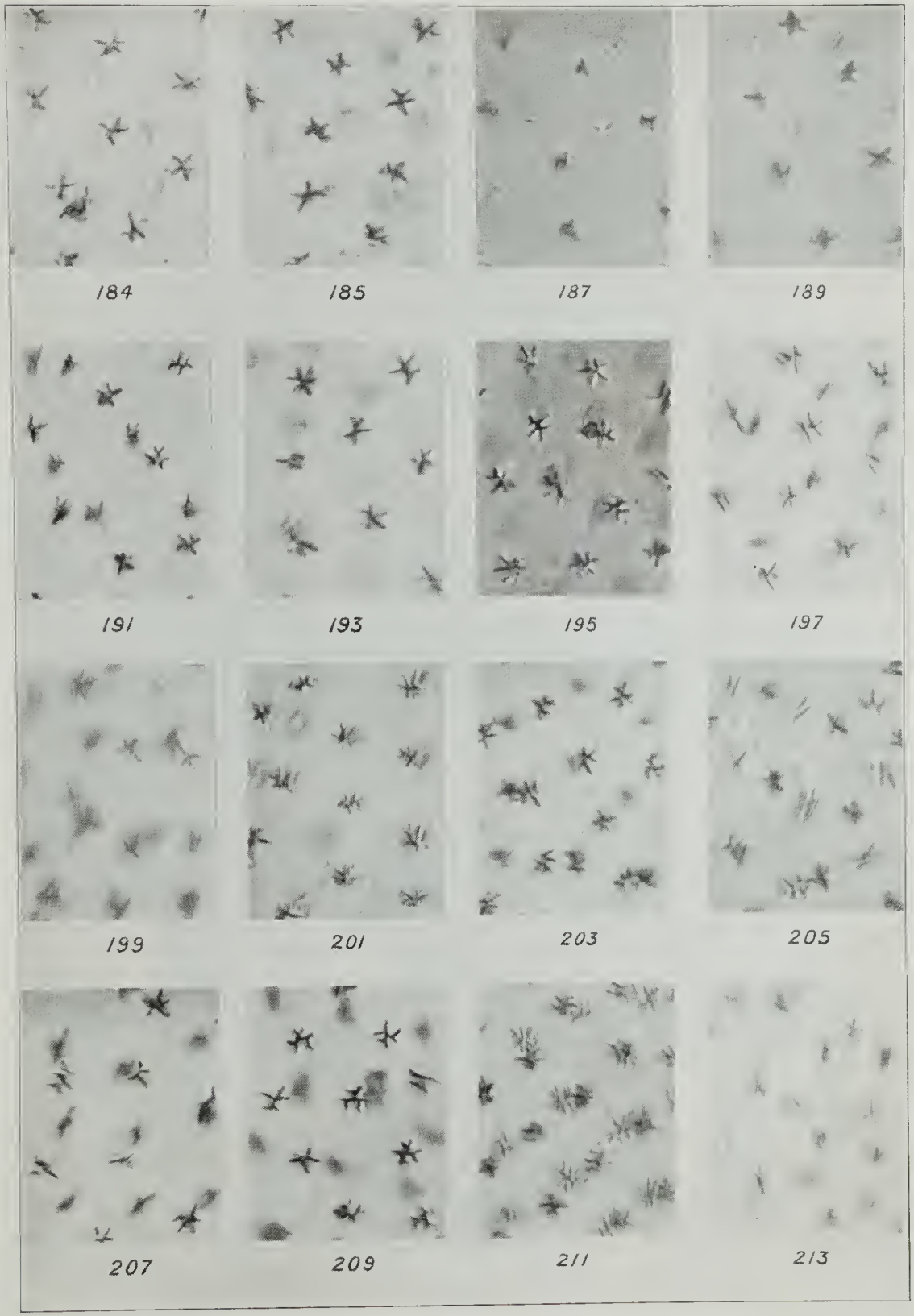
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MONOGRAPH ON THE TRIASSIC FLORA OF BALD HILL, BACCHUS MARSH, VICTORIA.

By Frederick Chapman, A.L.S., F.R.M.S., Palaeontologist to the National Museum, Melbourne.

(Plates X.–XIII. and text figure.)

I.—Introduction .. ..
II.—Previous References .. ..
III.—Description of the Plant Remains .. ..
IV.—Range in Time of Genera and Species .. .. .
V.—Geographical Relationships of the Fossils .. .. ..
VI.—Conclusions .. ..
VII.—Bibliography .. ..

I.—INTRODUCTION.

The existence of a Triassic flora in the Bacchus Marsh District was suggested and tentatively held by geologists for many years, but the evidence had been obscured by the confusion of two horizons. Thus, Sir Fredk. McCoy was always impressed with the Triassic aspect of the Bacchus Marsh flora as a whole; and the earlier mistaken view, that the "*Schizoneura* bed" occurred beneath the *Gangamopteris* sandstone of Bacchus Marsh, only added to the difficulty.

Writing in 1892, McCoy[1] said that he recognized Lower Triassic rocks in specimens obtained by W. H. Ferguson "from a newly discovered bed just under the famous *Gangamopteris* sandstone of Bacchus Marsh," in which he identified *Schizoneura* and *Zeugophyllites*.

Apparently the error of inverting the relative positions of these two beds arose through a slip in drawing the preliminary sketch, though Mr. Ferguson correctly represents in sketch-section No. 1, sent to the National Museum on 29th July, 1891, the *Gangamopteris* beds underlying the adjacent rocks that contain the *Schizoneura* flora (see text-fig. p. 123).

In some notes on glacial deposits of Bacchus Marsh, Messrs. Officer and Balfour[2] refer to McCoy's determination of *Schizoneura* and *Ptilophyllum* from this locality, and state "They all come from the *Schizoneura* bed—a thin clayey band about 4 inches in width. The horizon is apparently above that of the *Gangamopteris* beds."

1 McCoy, F. 1892, p. 30. (Full references are given at the end of this work.)
2 Officer and Balfour 1894, p. 143.

Since these references to a Triassic flora were made, *Taeniopteris Sweeti* has been discovered, and the present writer has reviewed this and other forms of the flora in later papers, notes on which are made in the next section, on the literature.

Quite lately other fossils have been collected by Mr. F. A. Singleton, M.Sc., and myself. These, together with the original examples collected by Mr. Ferguson in 1891, many of which have never been referred to, seem to fairly establish the claims of this interesting bed as a representative of the Triassic system in Victoria.

The classic section in which these plant remains are found is in a trench in the Council Paddock at Bald Hill: and it may be usefnl for future collectors to refer to the appended notes, which were made by Mr. Singleton and myself, of the exposed beds. It may be remarked that Messrs. Officer and Balfour gave details only slightly differing from those now furnished, in their paper on the Bacchus Marsh glacial beds.[3]

GENERALIZED SECTION SEEN IN THE TRENCH AT THE COUNCIL PADDOCK, BALD HILL, JULY, 1919. (SINGLETON AND CHAPMAN).[4]

Bed.	ft.	in.
8. Sandy shale	2	0
7. Pebbly conglomerate, grits and chert, with ferruginous cement (circ.)	1	6
6. Plant remains in fine siliceous sandy shale	0	5
5. Friable, current-bedded sandy shales with sericite	0	8
4. Shaley siliceous mudstone with plant remains	0	6
3. Current-bedded sandy shales	4	0
2. Parting, with pebbles	0	1
1. Current-bedded sandy shale (circ.)	10	0

Base of trench.

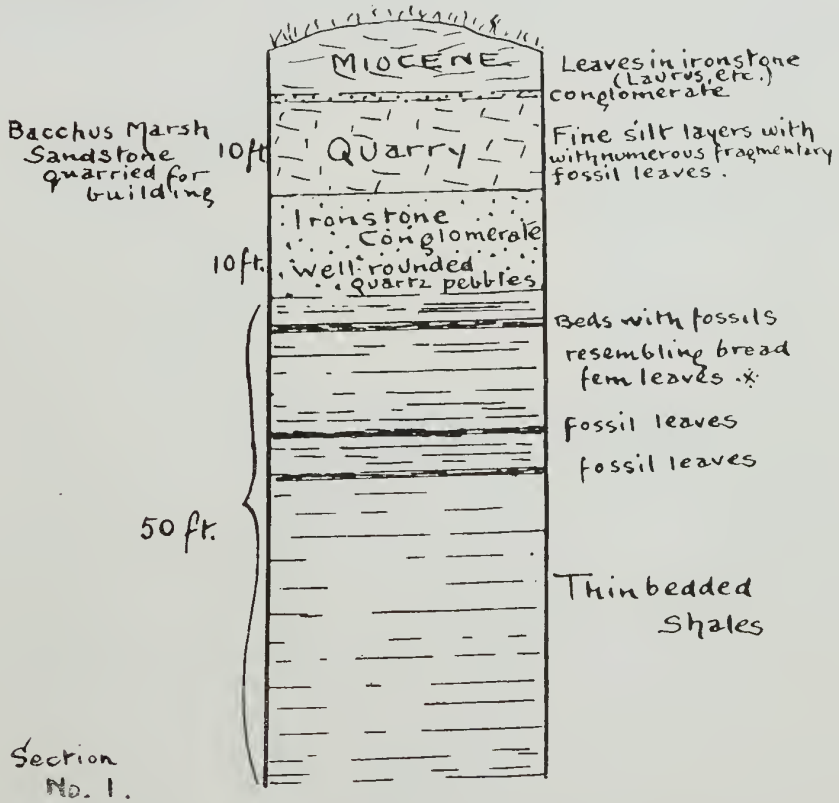
II. PREVIOUS REFERENCES TO THE LATER FLORA OF BALD HILL.

FERGUSON, W. H., 1891.[5]—This was the first notice by the discoverer, Mr. Ferguson of the Geological Survey of Victoria, of the higher horizon with plants, at Bald Hill. The description runs as follows: "At the Bald Hill a shallow quarry has been excavated along the crest of a ridge for about 150 yards; a bed of very fine-grained siliceous sandstone outcrops here, and in it are numerous fossils new to the Bacchus Marsh Sandstones. They are quite distinct from the fossil fern, *Gangamopteris*, which up to the present was the only fossil plant found in the formation. The

3 *Id.*, 1894, p. 140.
4 Further stratigraphic comments on this section will be made in a paper to be published by Mr. F. A. Singleton, who will deal with the relationships of the beds of this locality.
5 Ferguson, W. H., 1891, pp. 31–32.

fossils are generally casts, but are occasionally preserved as a film of carbon. The layer that contains the fossils thins out and thickens most capriciously, and is replaced by a conglomerate, which consists of an ironstone matrix thickly studded with small quartz pebbles, and differs in general appearance from the glacial conglomerate of the district. The new fossils have been sent to Professor McCoy for identification. The deposit is covered by Miocene sands and ironstone layers containing dicotyledonons leaves. The fossiliferous siliceous sandstone rests on 10 feet of ironstone conglomerate, and below the conglomerate in sandy and earthy layers, stained by oxide of iron, fossil leaves resembling *Gangamopteris* may be obtained and also pieces of wood. About 300 yards to the north of this quarry showing the siliceous rock, a quarry has been opened up in massive sandstone. This foundation lies between glacial conglomerate and yields various species of *Gangamopteris*."

Ferguson, W. H., 1891.—A manuscript report (in the National Museum), not hitherto published, was forwarded by A. W. Howitt, Secretary for Mines, to McCoy on 29th July, 1891. These are notes to accompany a box of fossils from Bacchus Marsh, sent to Professor McCoy :—



Sketch-section by W. H. Ferguson, 29.7.91, at Bald Hill. Fossils obtained in small quarry on hillside. Scale 20ft. to 1in.—reduced

* Probably the *Ptilophyllum*.

"At section No. 1, showing fine silt layers resting on ironstone conglomerate, there were obtained 35 samples of white, grey, and yellow very fine-grained sandstone containing numerous plant impressions. Small specimen in siliceous stone resembling rootlets and marked unique was the only one of that kind found. Of specimen No. 1, an eight-rayed fossil, the Department possesses a duplicate. Five specimens, four of leaves and one of wood, marked fossil leaves, in earthy, sandy ironstone layers 20 to 30 feet below silt layers were found in beds indicated by red lines on section.

At section No. 2 the fossil fern leaves, in grey sandstone, marked Numbers 4, 5, 6, were found as indicated by an arrow on the section. Th especimens of fossil leaves, casts of fruits or seeds and sample of wood, all in ironstone, were collected at two localities, some on the N.E. bank of the Werribee River about 2 miles below the Gorge, others on a hill 200 yards west from bridge where Ballan-road crosses the Korkuperrimal or Lyall's Creek, and about 2 miles from Bacchus Marsh Township." (N.B. The latter reference relates to Tertiary plant remains.—F.C.).

McCoy, F., 1892.[6]—That author places on record his discovery of *Schizoneura* and *Zeugophyllites* in the collection obtained in 1891 by W. H. Ferguson. An error is made here in placing the newly discovered bed "just under the Gangamopteris sandstone," which misled McCoy to correlate both series with the Trias.

Officer, G., and Balfour, L., 1894.[7]—In describing the glacial deposits of Bacchus Marsh, they refer to *Schizoneura* and another genus, *Ptilophyllum* (*P. Officeri*) McCoy. Sir Fredk. McCoy's description of the latter species is included in this paper.

Etheridge, R., Jun., 1894.[8]—Referring to Sir F. McCoy's determination of *Schizoneura*, as recorded in the Ann. Rep. Secy. for Mines, 1891, he remarks:—"It will be observed that the specimens are spoken of as comminuted." In this paper Etheridge describes *Schizoneura australis*, sp. nov., occurring between the Upper Coal Measures and the Hawkesbury Sandstone.

David, T. W. E., 1896.[9]—In this paper the two beds at Bald Hill are mentioned as follows:—"Well preserved plant remains are present on at least two horizons; on the lower horizon occur the three species of *Gangamopteris* already referred to, and on the higher, specimens of *Zeugophyllites*, *Schizoneura*, &c. The total thickness of the glacial beds seen in the upper portion of Korkuperrimal Creek, as measured last December, proved to be 1,427 feet. To this, Mr. Brittlebank estimates a thickness of about 700 feet of strata should be added, to carry the section from the top of the *Gangamopteris* beds to the top of the strata seen above the *Schizoneura* horizon."

6 McCoy, F., 1892, p. 30.
7 Officer, G., and Balfour, L., 1894, p. 143.
8 Etheridge, R. jun., 1894, p. 32–33.
9 David, T. W. E., 1896, p. 298.

McCoy, F., 1898.[10]—A new species of *Taeniopteris* (*T. Sweeti*) is described from the upper beds at Bald Hill. In the original description McCoy states this fossil to come from the *Gangamopteris* Sandstones at Bald Hill, whereas by the matrix it is seen to belong to the *Schizoneura* bed.

Arber, E. A. N., 1905.[11]—A reference is given to "*Taeniopteris* sp. (from Victoria)," the author stating that—"This genus occurs rarely with *Gangamopteris* in the Bacchus Marsh Sandstones of Victoria." He also regards the specimen as "too fragmentary to permit of an accurate specific diagnosis." The genus was thought only so far to have occurred once, but whilst examining the late Mr. Geo. Sweet's collection, donated to the National Museum by his daughter, Dr. G. Sweet, several fragmentary specimens were found. This fossil does not occur with *Gangamopteris*, as Newell Arber thought, and the original type, as well as some of the other fragments, is in good condition.

Chapman, F., 1914.[12]—The author transfers the genus *Zeugophyllites* to *Phoenicopsis* and mentions the occurrence of *Taeniopteris* (*Macrotaeniopteris*) in the upper beds of Bald Hill.

Chapman, F., 1919.[13]—*Taeniopteris Sweeti* is referred to. *T.* (*Macrotaeniopteris*) *wianamattae* Feistmantel, and *Ptilophyllum Officeri* McCoy is identified with *Ptilophyllum oligoneurum* T. Woods, now a synonym of *Ptilophyllum* (*Williamsonia*) *pecten* Phillips sp.[14]

III.—DESCRIPTION OF THE PLANT REMAINS.

Series—**PTERIDOPHYTA.**

Class—**EQUISETALES.**

Genus—Phyllotheca, Brongniart, 1828.

Phyllotheca indica Bunbury.

Plate X., figs. 4, 6, 9. Plate XI., fig. 15.

Phyllotheca indica Bunbury, 1861, Quart. Journ. Geol. Soc., vol. XVII., p. 335, pl. X., figs. 6–9. Schimper, 1869, Traité de Paléont. Vég., vol. I., p. 289. Feistmantel, 1876, Journ. Asiatic Soc., Bengal, vol. LXV., pt. 2, p. 346. Idem, 1880, Mem. Geol. Surv., India—Pal. Indica, ser. XII.—Flora of the Gondwana System, vol. III., pts. 2 and 3, p. 67, pl. XIIa., figs. 3–9. Oldham, 1893, Manual Geol., India, pl. opp. p. 162. Seward, 1898, Fossil Plants, Cambridge Univ. Press, vol. I., p. 287, fig. 680. Arber, 1905, Cat. Foss. Plants, Brit. Mus., "The Glossopteris Flora," p. 20, text-fig. 6.

10 McCoy, F., 1898, p. 285.
11 Arber, E. A. N., 1905, p. 128.
12 Chapman, F., 1914, p. 68.
13 Chapman, F., 1919, pp. 149–50.
14 Walkom, A. B. 1917, p. 14.

Observations.—The plant-stems in the present series, referred to *Phyllotheca indica*, have the characteristic short internodes seen in the Raniganj fossil remains. The slender filamentous leaves found attached, or in close association with the stems, show their relationship to the above species rather than to *P. australis*, which has the leaf-whorls more closely adherent to the stem. This conclusion is further supported by the form of the internodes, which tend to widen distally and also bear strong, linear, superficial grooves. The stem in one example (fig. 4) consists of about eight segments, whilst the other (fig. 15) has seven; it is slender and closely comparable with some of Feistmantel's figures of this species.

Dimensions of the Victorian Specimens.—The stem here figured (fig. 4) measures at its widest part about 2·3mm.; the second specimen (fig. 15) has a stem diameter of only 1·5mm. Indian specimens figured by Feistmantel measure from 2·5 to 5mm. in diameter. As a contra-comparison, a typical example of *Phyllotheca australis* in the National Museum collection has a stem-diameter of 14mm.

Leaves.—Although complete leaf-whorls have not been preserved in the present instances, the occasional leaves are similar to those of *P. indica*, both in shape and habit. The leaves are of moderate length, aciculate, and are bent outward or upward from their point of attachment, and often strongly recurved near the extremity.

Rhizomata with Tubers.—Portions of straight or flexuous rhizomes, bearing sac-like bodies appended by a filamentous attachment, are not uncommon on some of the slabs of cream-coloured, porcellanous mudstone from the trench on Bald Hill, two of which are figured (figs. 6 and 9). The coarse sclerenchymatous texture of the rhizome is shown in strong relief, whilst the attaching filaments and tubers are of a more tenuous structure. The latter are represented by a thin impression or mere stain on the rock. These sac-like bodies are not so well-rounded as in modern *Equisetaceae*, or the fossil *Equisetites* figured elsewhere.[15] This irregular form of the tubers may therefore be peculiar to the allied genus *Phyllotheca*, to which, up to the present, no rhizomes or tubers seem to have been assigned. Since these tubers are here associated in the same horizon and on the same slabs, their probable relationship to *P. indica* seems to be fairly strong.

Nodal Diaphragms.—In fig. 15 can be seen two nodal diaphragms, and since they are disposed at right angles to the surface of the stem-nodes, seem to point to their having been the nodal attachment of branches; otherwise to account for their present position on the stem would necessitate their displacement to a plane at right angles to their original position, and this could hardly have taken place

15 See *E. Burchardti* Dunker, figured by A. C. Seward, 1898, p. 279, fig. 65; or *E. yokohamae* Seward, ibid, p. 280, fig. 66. Also *E. wonthaggiensis* Chapman, 1912, pl. XII., fig. 1.

without a great amount of distortion in the stem. These nodal diaphragms, although small, are not comparable in detailed structure with Arber's New Zealand species, *Phyllotheca minuta*,[16] unless it could be proved that these apparent nodes of the branches differed from the nodes of the stem, to which Arber's figured specimens seem to belong.

Distribution.—*Phyllotheca indica* Bunbury, has not before been recorded from Australian rocks. It is found in India in the Raniganj sub-stage of the Damuda stage (Upper series of Lower Gondwana).

Divisions of the Lower Gondwana (for reference above)—

Stage	..	.. Damuda	..	{ Raniganj Ironstone Shales Barakar
Stage	..	.. Talchir	..	{ Karharbari Talchir proper.

Phyllotheca australis Brongniart.

(Plate XI., fig. 16.)

Phyllotheca australis Brongniart, 1828, Prodr. Hist. Végét. Foss., p. 152. McCoy, 1847, Ann. Mag. Nat. Hist., vol. XX., p. 156.

Phyllotheca ramosa McCoy, 1847, ibid., p. 156, pl. XI., figs. 2, 3.

Phyllotheca Hookeri McCoy, 1847, ibid., p. 157, pl. XI., figs. 4–6.

Phyllotheca concinna T. Woods, 1883, Proc. Linn. Soc. N.S. Wales, vol. VIII., pt. I., p. 75, pl. IX., fig. 2.

Phyllotheca australis Brongn., Feistmantel, 1890, Mem Geol. Surv., N.S. Wales, Pal. No. 3, p. 79, pl. XIV., figs. 2–5. Arber, 1905, Cat. Foss. Plants, Brit. Mus.—The Glossopteris Flora, p. 17, pl. II., figs. 6–8. Walkom, 1915, Queensland Geol. Surv., Publ. No. 252, "Mesozoic Floras of Queensland," pt. I., p. 32, pl. I., fig. 5,[17] Walkom, 1925, Paper, T., Proc. Roy. Soc. Tas. for 1924, p. 74.

Observations.—From an examination of the type specimen in the Museum of the Geological Society of London, Prof. A. C. Seward[18] was of the opinion that it is impossible to distinguish between *P. indica* and *P. australis*. So far as the present writer has been able to judge, from the Australian examples and from the fuller drawings by Feistmantel of *Phyllotheca indica*, there are some notable points of difference between the two species, which were also remarked upon by Newell Arber.[19]

16 Newell Arber, 1917, p. 27, pl. II., figs. 5 and 9.
17 For more complete synonymy, see Arber, 1905, p. 17.
18 Seward, 1898, p. 288.
19 Arber, 1905, p. 21.

The almost perfect leaf-sheath here figured (fig. 16) shows its characteristic contracted form. It can be matched with a stem of equal diameter in the National Museum collection, having the whorls in position, and which was obtained from the uppermost coal seams at Newcastle, New South Wales.

The figured specimen referred by Dr. Walkom to this species, from the Ipswich Series (Trias.), of Denmark Hill, Ipswich, Queensland, has more distinctly separate leaves than usual; their shortness and narrowness makes them referable to *Phyllotheca* rather than to *Neocalamites*, as Walkom has remarked.

Phyllotheca concinna T. Woods, from the Hawkesbury Sandstone of Sugarloaf Hill, New South Wales, represents a probable joint with indications of leaf-sheaths, and not unlike the specimen here figured (fig. 16).

Dimensions. The leaf-whorl, as preserved in the Bacchus Marsh specimens, has a maximum diameter of 26mm., whilst the height of the whorl, that is, the length of the longest leaves, is 35mm.

Distribution. *Phyllotheca australis* is confined to Australia and Tasmania. It is commonest in the Middle and Upper Coal Measures (Permian) of New South Wales, but is occasionally found in the Triassic. The Ipswich Series, in Queensland, of similar age, contains this species, as recorded by Dr. Walkom; and there is a specimen from Brisbane in the National Museum. Feistmantel recorded *Phyllotheca australis* from the Mersey Coal-field and the Jerusalem Basin of Tasmania.[20]

The record of *Phyllotheca australis* in the Progress Report (No. III.) of the Victorian Geological Survey, p. 60, as occurring in the Jurassic of Cape Patterson, appears to be open to some doubt. The specimen has not been found in the collection of the National Museum; there is, however, an example from the Albert River, Gippsland, labelled by McCoy as *P. australis*, but this identification seems open to question, as only the denuded stem is seen, with traces of joints, and might more justifiably be referred to *Equisetites* which is not uncommon in those beds. The Gippsland Coal-measures, have generally been accepted as the equivalent of the upper Mesozoic of Queensland (Walloon Series), but there are a few interesting occurrences of exceptional plant species which may, with further study, prove the existence of a Triassic flora as well, and which, from the already known evidence, must be the case in Tasmania. The working out of the exact succession of floras, in both areas is much to be desired. That for Tasmania has already been commenced by Dr. Walkom, who has recently published a paper on Tasmanian Mesozoic Plants,[21] and the writer, in collaboration with Miss I. Cookson, hopes shortly to undertake the description of the Victorian Mesozoic Flora.

20 Feistmantel, 1890, pp. 59–60.
21 Walkom, 1925.

Genus Schizoneura, Schimper and Mugeot, 1844.

Schizoneura microphylla sp. nov.

Plate X., figs. 1–3, 5, 7, 8, 10–12. Plate XI., figs. 13, 14, 17, 18. Plate XII., fig. 35. Plate XIII., figs. 43, 48.

Description.—Stems long, straight, moderately slender; surface fluted; pith-casts strongly grooved. Jointed at distant intervals. Leaflets apparently forming a loose sheath and numbering about 7 to 10, small, aciculate or pointed ovate, sometimes with blunt apices and traces of fission. Bases of leaves inserted in depressions at the nodes. Nodal diaphragms present, resembling those of *Equisetites*, but radially grooved to the centre. Vestiges of diaphragms seen attached to the stems in the fossils, probably representing in some cases the junction of branches.

Evidence of Fruiting Cone.—In 1903 Mr. R. Etheridge, jun., figures a specimen of *Schizoneura* from the Upper Coal Measures of New South Wales,[22] having on the end of the leaf-bearing axis two strobils, 2 to 2·5 cm. long. As Newell Arber remarks,[23] "the preservation is not sufficiently good to afford any details as to the morphological structure of the cone."

In this present instance we are more fortunate, since the surface of the cone is beautifully preserved, showing a polygonal cellular structure, probably the bases of sporophylls, which apparently having shrunken, have been resolved into a series of subangulate areas, each with a central pit. To the sides of the fruit are attached sharply pointed uninerved, bracteate sporophylls, and these were in all probability disposed over the surface and were detached before fossilization. The grooved pith-cast of the stem to which the fruit is joined, leaves no doubt as to the relationship of this cone to *Schizoneura microphylla*. This cone measures 6mm. in length: the width of the base of the body of the fruit being 2mm., whilst the total width of the cone with the bracts measures 7.5 mm.

Leaves.—The leaflets of the whorl are seen in figs. 1, 2, 3, 7, 8, 11, 12, 13 and 17. In figs. 1, 3, 8, 11 and 12 they are slender, aciculate to acutely pointed, or calamitean; whilst in 13 and 17 they are distinctly truncated. It is quite possible, however, that these latter may eventually be proved to belong to another species, especially since the venation is more distinctly parallel than in the other aciculate forms. The probable number of leaflets to the whorl in this species is about 5. In fig. 17 the nodal diaphragm forms an interesting feature between the only two leaves of the whorl preserved. Figs. 2 and 14 evidently represent the actual

22 Etheridge, R., jun., 1903, p. 234, pls. XLVIII. and XLIX.
23 Arber, 1905, p. 9.

surface impression of the stem, as the flutings are not deeply impressed ; in fig. 2 the starlike appearance in the middle of the fossil may indicate the cracking of the cortex by pressure taking place over a newly forming branch.

Nodal Diaphragms.—That seen in fig. 5 is so like the form in *Equisetites* that one might pause before referring it to *Schizoneura*, of which there have apparently been as yet no records in the present assemblage. But the discovery of other *Schizoneura* stems with the nodal diaphragms more or less in position, makes their reference to this genus certain. In *Schizoneura* the radii of the diaphragm are perhaps less numerous than in *Equisetites*, but the central papilla is well developed as in that genus as would be expected from their similarity in general structure.

Dimensions—

Diameter of widest stem, 7·5 mm.
Diameter of an average stem, circ, 6 mm.
Longest stem-fragment preserved, 10·5 cm.
An aciculate leaf measures 19 mm. by 2·5 mm. at the base.
Internodes often seven times the width of the stem.

Observations.—The stems of the above species of *Schizoneura*, as they are preserved in the Bacchus Marsh siliceous mudstones, are conspicuously straight, and distinctly and deeply grooved in the pithcasts, or with parallel sulcations when the surface impression is represented. The nodes are very distant and not always clearly visible. It was undoubtedly the character of the straight and conspicuously grooved stems with distant nodes that led McCoy to place these plant remains, apparently without hesitation, in the genus *Schizoneura*, for the leaf remains associated with these stems are very indistinct. It was only by carefully scanning every piece of material with a lens, that the fragmentary evidence here figured was obtained.

As regards the narrow, straight, and deeply grooved stems with inconspicuous leaf-sheaths, these structural characters find their nearest relationship with the smaller foliaceous varieties of *Schizoneura*, like *S. meriani* Schimper, of the Kenper of Stuttgart.

Comparisons.—Species like *Schizoneura gondwanensis*, Feistmantel, *S. australis* Etheridge, jnr.[24] and *S. africana*, Feistmantel, have the leaf-sheath typically developed from a basal sheath into a pair of large oblong-ovate leaves, with occasional sheaths with narrow leaflets. These leaflets may number, as in *S. gondwanensis*, as many as ten. In the present species one of the distinctive characters is the apparently uniform, aciculate, leaf-like whorl, the

24 In passing it may be pointed out that Newell Arber, in his *Glossopteris Flora*, pp. 5 and 9 (*loco supra cit.*), regards *S. australis* Eth. jun. as a synonym of *S. gondwanensis*

separate components of which amount to about five. It would be unsafe to assume that the large paired ovate leaves did not exist in this form, but no evidence is seen in the present series, whilst the leaflets are comparatively abundant.

It is just possible that the specimens figured by Feistmantel as *Schizoneura gondwanensis*[25] from the Damuda Series and associated with a flora of Triassic affinities represent an undescribed form and more nearly related to the above, *S. microphylla*. In these figures the leaf whorls are shown to be more irregularly divided into several linear or wedge-shaped leaves, which are characteristically split at the apex. A comparison of this form with figs. 1, 3, and 7 of the present series shows a close resemblance where the leaflets of the latter are obtuse, or with a slight cleavage.

Class—**FILICALES.**

Fam.—**Cyathaceae.**

Genus—Coniopteris, Brongniart, 1849.

Coniopteris delicatula Shirley sp.

(Plate XI., figs. 24, 28.)

Coniopteris delicatula Shirley.

Coniopteris delicatula Shirley. 1898, Queensland Geol. Surv. Bull. 7, p. 18, pl. X., fig. 1.

Triphyllopteris botryoides Shirley, 1898, ibid., p. 20, pl. XVII., fig. 1.

Coniopteris delicatula Shirley sp., Walkom, 1917, Queensland Geol. Surv. (Dept. Mines), Publ. No. 257, pt. I. continued (Filicales), p. 6, pl. IV., fig. 2; text fig. 3.

Observations.—The flexibility of the rachis and the almost ragged tips of the pinnules would preclude a reference of the above figured specimens to Shirley's *Sphenopteris superba*,[26] to which it otherwise bears some resemblance. It is difficult indeed to separate the two genera on mere fragments, for the same type of venation occurs in both. The balance of evidence, however, seems in favour of a reference to *Coniopteris* because of the less rigid character above noted. Figure 28 represents the apical part of a pinnule with both acuminate and blunted tips to the lobes. Figure 24 has the bases of the pinnules expanded, and they are not so deeply incised as in Walkom's figure 2 on plate X.; but this may be the result of dessication before fossilization.

Distribution.—*Coniopteris delicatula* was known only from the Ipswich Series (Trias.) of Shorncliffe, Sandgate, Queensland

25 Feistmantel, 1879, p. 9, pl. I., figs. 2 and 3.
26 Shirley, 1898, p. 18, pl. IV., fig. 8.

Fam.—**Thinnfeldieae** Walkom, 1917.

Genus—Thinnfeldia Ettingshausen, 1852.

Thinnfeldia Feistmantelli Johnston.

(Plate XII., fig. 30).

Thinnfeldia Feistmantelli Johnston, 1895, Proc. Roy. Soc. Tasmania figs. 2, 16.

Thinnfeldia odontopteroides, var. *triangulata* Shirley, 1898, Queensland Geol. Surv., Bull. 7, p. 22, pl. X., fig. 2.

Thinnfeldia odontopteroides, var. *normalis* Shirley, 1898, ibid., p. 21, pl. XI.

Thinnfeldia odontopteroides, var. *rhachidis* Shirley, 1898, ibid., p. 21.

Thinnfeldia odontopteroides (pars.) Seward, 1910, Fossil Plants, vol. II., p. 538, fig. 356 (A, B, D), 357.

Dicroïdium Feistmanteli Johnston sp., Gothan, 1912, Abhandl. Naturh. Gesellsch. Nürnberg, vol. XIX., heft 3, p. 78, pl. XVI., fig. 1. Antevs, 1913, K. Svensk. Vetenskaps Akad., Handl., vol. L., No. 5, p. 3, pl. I., figs. 1 7. Idem, 1914, ibid., vol. LI., No. 6, p. 52, pl. I., figs. 5, 6; pl. V., fig. 1.

Thinnfeldia Feistmanteli Gothan sp., Arber, 1917, New Zealand Geol. Surv., Palaeont. Bull., No. 6, p. 49, pl. V., fig. 4.

Thinnfeldia Feistmanteli Johnston, Walkom, 1925, Papers and Proc. Roy. Soc., Tasmania for 1924, p. 77, fig. 4.

Observations. In the absence of the distinctive feature of the branching rhachis of the frond, the above determination may be regarded as somewhat provisional; but the rhombic form of the pinnules and thickened rachis points, however, in the direction of the above species. The form of the pinnules and the odontopteroid venation compare very closely with specimens from the Trias of Leigh's Creek Coalfield, South Australia.

The figured specimen was collected by the late Dr. T. S. Hall, and is now in the National Museum.

Distribution—Mesozoic: Tasmania. Ipswich Series (Triassic) and Walloon Series (Jurassic) of Queensland. Trias., South Australia. Rhaetic: Argentine and New Zealand.

Thinnfeldia lancifolia Morris sp.

(Plate XI., figs. 20, 21).

Pecopteris odontopteroides, var. *lancifolia* Morris, 1845, in Strzelecki's Physical Description of New South Wales, p. 249, pl. VI., fig. 4.

Thinnfeldia media T. Woods, 1883, Proc. Linn. Soc., N. S. Wales, pl. VI., fig. 1.

Thinnfeldia odontopteroides Morris sp., var. *falcata*, T. Woods, 1883, ibid., pl. VIII., fig. 1.

Thinnfeldia odontopteroides Morris, sp. var. *superba*, Johnston, 1885, Papers and Proc. Roy. Soc. Tasmania, p. 372.

Thinnfeldia media T. Woods, Johnston, 1888, Geol. Tasmania, pl. XXIV., fig. 5.

Pecopteris (*Thinnfeldia*) *odontopteris* Morris, Johnston, 1888, ibid., pl. XXV., figs. 1, 2, 4.

Thinnfeldia superba Johnston, 1888, ibid., pl. XXVI., figs. 4, 5.

Thinnfeldia laneifolia Morris sp., Szajnocha, 1888, Sitzungsb. d. k. Akad. Wiss. Wien, vol., XCVII., p. 231, pl. I., figs. 4B, 5–7.

Thinnfeldia odontopteroides Morris sp. (pars), Feistmantel, 1890, Mem. Geol. Surv. N.S. Wales, Palaeontology, No. 3, pl. XXIX., fig. 4 (?).

Thinnfeldia odontopteroides Morris sp. var., Etheridge jnr., 1892, Geol. and Palaeont., Queensland, pl. XVII., fig. 7.

Thinnfeldia media T. Woods, Etheridge jnr., 1892, ibid., pl. XVIII., fig. 10.

Thinnfeldia buftoni Johnston, 1896, Papers and Proc. Roy. Soc. Tasmania for 1894–5, p. 61, fig. 18.

Thinnfeldia indica Feistmantel, var. *aquilina*, Shirley, 1898, Queensland Geol. Surv., Bull. No. 7, p. 21, pl. VI., fig. 2.

Thinnfeldia indica Feistm. var. *media*, Shirley, 1898, ibid., pl. V., fig. 1.

Thinnfeldia odontopteroides Morris sp. (pars.), Dun, 1909, Rec. Geol. Surv. N.S. Wales, vol. VIII., p. 314, pl. XLIX., fig. 1.

Dicroïdium lancifolia Morris sp., Gothan, 1912, Abhandl, Naturh. Gesellschaft Nurnberg, vol. XIX., p. 78, pl. XVI., figs. 2–4.

Thinnfeldia lancifolia Morris sp., Arber, 1913, Proc. Roy. Soc. Lond., Ser. B., vol. LXXXVI., p. 346, pl. VIII., fig. 7.

Dieroïdium lancifolium Morris sp., Antevs, 1914, K.Svenska Vet. Akad. Handl., vol. LI., No. 6, p. 58, pl. V., figs. 6, 7.

Thinnfeldia lancifolia Morris sp., Walkom, 1917, Queensland Geol. Surv. Publ. No. 257, p. 21, pl. III., fig. 3; pl. IV., fig. 1; pl. VII., fig. 2; text-fig. 6. Arber, 1917, New Zealand Geol. Surv. Palaeont., Bull. No. 6, p. 49, pl. V., figs. 1, 2, 6. Walkom, 1925, Papers and Proc. Roy. Soc. Tasmania for 1924, p. 78.

Observations. The pinnules here figured are quite typical as compared with those seen in the median part of the frond of *T. lancifolia*. The distinct and characteristic midrib forks and dies out before reaching the apex. The absence of the incurvation of the upper margin of the pinnule near the base precludes its reference to *T. indica* Feistmantel.

Distribution. Found in both the Trias (Ipswich Series) and the Jurassic (Walloon Series) in Queensland, Mesozoic of Tasmania. The Rhaetic of New Zealand and the Argentine.

Thinnfeldia odontopteroides Morris sp.

(Plate XI., fig. 19.)

Pecopteris odontopteroides Morris, 1845, in Strzelecki's Description of New South Wales, p. 249. figs. 2 and 3. Carruthers, 1872, Quart. Journ. Geol. Soc., vol. XXVII., p. 355. pl. XXVII., figs. 2, 3.

Thinnfeldia obtusifolia (pars.) Johnston, 1888, Geol. Tasmania. pl. XXV., figs. 7, 14; pl. XXVI., figs. 21, (?) 7, (?) 15.

Thinnfeldia odontopteroides Morris sp., Feistmantel, 1890. Mem. Geol. Surv. N. S. Wales. Palaeontology, No. 3, pl. XXVI., fig. 2; pl. XXVIII., fig. 8; pl. XXIX., figs. 1, 2, 3, 5. Etheridge, jnr., 1892, Geol. and Pal., Queensland. pl. XVII., fig. 1. Dun, 1909, Rec. Geol. Surv. N.S. Wales. vol. VIII., pl. XLIX., fig. 2. Seward, 1910, Fossil Plants, vol. II., p. 538, fig. 358.

Dicroïdium odontopteroides Morris sp., Gothan 1912, Abhandl, Naturh. Gesellsch. Nurnberg, vol. XI. heft 3, p. 78, pl. XVI., fig. 5. Antevs, 1914, K. Svenska Vetenskaps Handl., vol. LI., No. 6, p. 55, pl. II., figs. 2, 3; pl. IV., figs. 6, 7.

Thinnfeldia odontopteroides Morris sp., Walkom, 1917, Queensland, Geol. Surv. Publ. No. 257, p. 19, pl. III., fig. 1. Arber, 1917, New Zealand Geol. Surv. Palaeont. Bull. No. 6, p. 50. Walkom, 1925, Papers and Proc. Roy. Soc. Tasmania for 1924, p. 78, fig. 5.

Observations. The pinnules here figured, representing as they do the typical oval and bluntly pointed shape seen usually in *T. odontopteroides*, is referred to that species. The venation is alethopteroid rather than odontopteroid as in most of the examples of *T. odontopteroides*. Arber[27] remarks, however, "nerves all arising directly from the rachis, and spreading throughout the lamina with dichotomy, or a more or less well-marked median nerve may

27 Arber, 1917, p. 50.

be present, giving off forked lateral nerves at an acute angle." Thus, according to that author, both types of venation may be present.

Distribution. Ipswich and Walloon Series of Queensland (Trias and Jurassic). Hawkesbury Sandstone and Wianamatta Shales of New South Wales; also at Dubbo, New South Wales; Leigh's Creek, South Australia (Triassic); Port Phillip, near Grice's Creek and South Gippsland (Jurassic).

FERN-LIKE PLANTS.—INCERTAE SEDIS.

Genus—Taeniopteris Brongniart, 1828.

Taeniopteris wianamattae Feistmantel sp.

(Plate XIII., fig. 51.)

Macrotaeniopteris wianamattae Feistmantel, 1878, Palaeontographica, Suppl. vol. III., Lief. 3, Heft 3, p. 107, pl. XIII., fig 2. Wilkinson, 1879, Ann. Rep. Dept. Mines, N.S. Wales, p. 215, pl. V. T. Woods, 1883, Proc. Linn. Soc. N.S. Wales, vol VIII., p. 118, pl. 10A. Feistmantel, 1890. Mem. Geol. Surv. N.S. Wales, Palaeont. No. 3., p. 116, pl. XXVII., figs, 1, 2. Etheridge, jun., 1892, Geol. and Pal. Queensland, p. 376. Dun, 1898, Austr. Assoc. Adv. Sci., vol. VII., p. 397.

Taeniopteris sweeti McCoy, 1898, Proc. Roy. Soc. Vict., N.S., vol. X., pt. II., p. 285, and text-fig.

Macrotaeniopteris woodsi Dun, 1898, Austr. Assoc. Adv. Sci., vol. VII., p. 399.

Taeniopteris sp. Arber, 1905, Cat. Foss. Plants (Glossopteris Flora), Brit. Mus., p. 128.

Taeniopteris (*Macrotaeniopteris*) sp. Chapman, 1914, Australasian Fossils, p. 88.

Taeniopteris wianamattae Feistm. sp., Walkom, 1917, Queensland Geol. Surv. Pub. No. 257, pt. I., p. 38.

Taeniopteris (*Macrotaeniopteris*) *wianamattae* Feistm. Chapman, 1919, Victorian Naturalist, vol. XXXV., No. 10, pp. 149, 150, 152.

Note on the Type-specimen of T. Sweeti McCoy.—I have carefully examined the type of *Taeniopteris Sweeti* described (ref. above) by McCoy, and find it to be identical in all the preserved characters, such as width of lamina, and spacing and forking of secondary veins, with *T. wianamattae*. This I have already stated in another place. In the original description McCoy says that the specimen came from the *Gangamopteris* Sandstone. The character of the matrix, however, clearly shows its origin to be from the upper, siliceous layer in the trench at Bald Hill (see remarks *antea*, p. 124).

Distribution of T. wianamattae.- In Queensland this species occurs at Ipswich, where it is rare (T. Woods); and at the Tivoli Coal Mine (R. Etheridge, jun.). Both of these localities are in the Ipswich Series, of Triassic age.

In South Australia the Leigh's Creek coal borings have revealed examples of *T. wianamattae.*[28] A re-examination of plants from that series, by Miss Cookson and myself, show also the presence of *Thinnfeldia Feistmanteli, Cladophlebis Albertsi, Taeniopteris Dunstani. T. cf. Tenison-woodsi* and *Equisetites rotiferum.* The balance of evidence, therefore. is strongly in favour of a Triassic age for the series and may be compared with the lower part of the Upper Coal Measures in Tasmania.

Series—GYMNOSPERMEAE.

Class—CYCADALES.

Genus—Ptilophyllum (Morris, foliage, 1841). Williamsonia (Carruthers, flowers, 1870).

Ptilophyllum (Williamsonia) pecten *Phillips sp.*

(Plate XII., fig. 36.)

Cycadites peeten Phillips, 1829, Geol. Yorkshire, p. 148, pl. VII., fig. 22.

Pterophyllum pecten Phillips sp. Lindley and Hutton, 1834, Fossil Flora, vol. II., pl. CII.

Ptilophyllum acutum Morris, 1840, Trans. Geol. Soc. Lond., ser. 2, vol. V., p. 327, pl. XXI., figs. 1–3.

Ptilophyllum oligoneurum T. Woods, 1883, Proc. Linn. Soc. N.S. Wales, vol. VIII., p. 149., pl. VII., figs. 2–4. Etheridge, 1892, Geol. and Palaeont, Queensland, p. 382, pl. VII., fig. 11; pl. XVI., fig. 2.

Ptilophyllum Offieeri McCoy, 1894, Proc. Roy. Soc. Vict., vol. VI., p. 143.

Williamsonia pecten Phillips sp., Seward, 1900, Cat. Mesozoic Plants, Brit. Mus. Jurassic Flora, vol. I., p. 190, pl. II., fig. 7; pl. III., text-figs. 30–35.

Ptilophyllum (Williamsonia) peeten Phillips sp. Walkom, 1917, Queensland Geol. Surv. Pub. No. 259, Mesozoic Flora of Queensland, pt. 1., p. 14, pl. V., fig. 6.

Ptilophyllum cf. *oligoneurum* T. Woods, Chapman, 1919, Victorian Naturalist, vol. XXXV., p. 150.

28 Chapman, 1919, p. 149.

Observations.—The present figured specimen of the frond of *Ptilophyllum pecten* in the Trias of Bacchus Marsh seems to bear out Newell Arber's conclusion that *P. acutifolium*, which that author has figured from the Middle Jurassic of Southland, New Zealand,[29] is distinct from the present species. The Bacchus Marsh specimens have the pinnae rather long, slender, and acuminate towards the tip. Unlike those of *P. acutifolium*, they are rather crowded and parallel-sided for quite two-thirds of their length.

Dimensions of figured specimen.—Width of frond, 28 mm. : length of frond, as figured, 66 mm. Length of longest pinna, 2 mm.

No evidence was obtained from the present series of specimens of the floral elements with microsporophylls. It may be noted, however, that occasional ovoid bodies like small nuts, enclosed in siliceous mudstone, when broken open, show a distinct cortex and within a mass of little seed-like bodies (see *postea*).

Distribution.—Previously known from the Jurassic of England, Germany, India, Graham Land, and Queensland ; and from the Lower Cretaceous of Greenland.

CYCADACEOUS FRUIT.

Plate XII., figs. 40, 40A

Description.—Several specimens of large, apparently ovoid or subcylindrical fruits, containing small seed-like bodies, are found in the present series. From their more or less distorted form, they must have been of soft texture when buried in the sediment. There appears to have been a fairly thick, spongy cortex, within which are crowded innumerable spherical bodies. These fruits remind one of the ovulate strobils of the Cycadoidea. The enclosed seeds closely resemble the megasporophylls seen in the figure of *Cycadeoidea* (*Bennettites*) *Gibsoniana* figured by Seward.[30] They measure about 1 mm. in diameter and are subspherical or polygonal. What appears to be a central vascular strand is present, as also the thick cortex shown in Seward's figure. The strobil measures 23 × 30 mm.

29 Arber, 1917, p. 53, pl. XI., figs. 1, 2, 5.

30 Seward, 1917, p. 392, fig. 521B.

Class—**GINKGOALES.**

Genus—Ginkgoites Seward, 1919.

Ginkgoites digitata Brongniart sp.

Plate XI., fig. 29.

Cyclopteris digitata Brongniart, 1828, Hist. Veg. Foss., p. 219, pl. LXI. bis, figs. 2, 3. Lindley and Hutton, 1883, Foss. Flora, vol. I., pl. LXIV. Dunker, 1846, Wealdenbildung, p. 9, pl. I., fig. 8; pl. V., figs. 5, 6.; pl. VI., fig. 11.

Ginkgo digitata Brongn. sp. Heer, 1877, Fossil Flora Arct., vol. IV. (1), p. 40, pl. VIII., fig. 1*a*; pl. X., figs. 1–6.

Salisburia digitata Brongn. sp. Saporta, 1884, Pal. Franc., vol. III., p. 294, pl. CLX., figs. 1–5.

Ginkgo digitata Brongn. sp. Seward, 1900, Jurassic Flora, Yorkshire (Brit. Mus.), part 1, p. 254, pl. IX., figs. 1, 2, 9, 10; text-fig. 45. Walkom, 1917, Queensland Geol. Surv. Publ. No. 259, pt. 1., concl. p. 8, pl. I., figs. 3, 4, 5.

Ginkgoites digitata Brongn. sp. Seward, 1919, Foss. Plants, vol. IV., p. 14, text-figs. 634, 639. Walkom, 1925, Papers and Proc. Roy. Soc., Tasmania, for 1924, p. 84.

Observations.—One of the leaf-fragments in the present series is clearly referable to the above species. It represents about one-third of a leaf, together with the petiole. The venation is characteristic in its simple dichotomy, the veins being spaced about 6 in 4mm. near the middle of the leaf. The margin is deeply divided. The type of leaf is exactly matched by Seward's figure 9 on pl. IX. of his Jurassic Flora, pt. 1.

Ginkgoites digitata is represented in the Ipswich beds (Trias), Queensland, by a good series, figured by Walkom.

Distribution.—The remains of leaves of the *G.digitata* type are of world-wide distribution, and they range from the Trias to the Jurassic. They are more commonly found in Jurassic strata, as in the floras of Yorkshire, Franz-Josef Land, Turkestan, India, Mongolia, Japan, and Victoria (Aust.).

Genus Baiera Braun, 1843.

Baiera darleyensis sp. nov.

Plate XII., figs. 32–34.

Description.—Leaf deeply incised, the extremities widely forked, either sharply truncated, as in *B. ipsviciensis* Shirley,[31] or outspread and laciniate. One specimen figured (fig. 34) shows a marked flexuosity or flaccidity of the lamina, but otherwise this agrees with the remaining types. The venation is rather close, about 5 to the lamina in the terminal portion. There is some resemblance to the Queensland species already mentioned, but the small size, about one-half to one-third the width, as well as the laciniate character of the terminations, separate this species from those previously described.

Dimensions.—Length of leaf, circ. 13mm. Width of incised portion of lamina, 1.5mm. to 2mm. and 3mm. at the apices. Divergence of tips, circ. 10mm. from point to point.

Observations.—The above species is in some respects an extreme form of the genus, and recalls Zalessky's genus *Ginkgopsis*.[32]

Remains of *B. darleyensis* are fairly abundant in the Trias of Bacchus Marsh. Our specimens are suggestive of the *B. ipsviciensis* figured by Shirley and Walkom from Queensland, but differ in important details which seem to be specific, as set forth above. The related *B. ipsviciensis* has only been found in Queensand, in the Trias (Ipswich Series) of Denmark Hill.

Genus—Stachyopitys Schenk, 1867.

(? Male Flowers of Ginkgoales.)

Stachyopitys cf. annularioides Shirley.

Plate XI., fig. 25.

Stachyopitys annularioides Shirley, 1898, Queensland Geological Survey, Bull. No. 7, p. 13, pl. XVII., fig. 1. Walkom, 1917, ibid., Publ. No. 259, p. 13, pl. IV., fig. 6.

Observations.—In fig. 25 is represented an annulate arrangement of bracteate leaves, which is in all probability related to Shirley's *Stachyopitys annularioides*. These remains, in isolated fragments, are quite common on the slabs with *Ginkgo* and *Baiera*; this association would seem to be more than a coincidence.

31 Shirley, 1898, p. 12, pl. III., fig. 2. Also Walkom, 1917, p. 11, p. IV., figs. 1 and 2.
32 Seward, 1919, p. 77.

Genus—Antholithus Heer, 1882.

(? Male Flowers of Ginkgoales.)

Antholithus sp.

Plate XI., figs. 22, 23, 26.

cf. *Antholithus*, sp. Seward, 1919, Fossil Plants, vol. IV., p. 52, fig. 654.

Observations.—The specimen above referred to is from the English Jurassic Series of Yorkshire.[33] These forms were noted as "pollen sacs of *Ginkgo*" by Seward in the earlier, British Museum, monograph; the leaflets are more regularly ovate than those now figured, the latter being more or less truncated and arranged with some regularity along a straight axis and are often petiolate.

Doubtful Ginkgoales.

Genus—Phoenicopsis Heer, 1877.

Phoenicopsis elongatus Morris sp.

Plate XI., fig. 27.

Zeugophyllites elongatus Morris, 1845, in Strzlecki's Phys. Descr. of New South Wales and Van Dieman's Land, p. 250, pl. VI., figs. 5, 5a.

Phoenicopsis elongatus Morris sp. Seward, 1903, Ann. S. African Mus., vol. IV., p. 67, pl. IX., figs. 1, 9, 10 Walkom, 1917, Queensland Geol. Surv., Publ. No. 259, p. 27, pl. IX., figs. 2, 3. Seward, 1919, Victorian Naturalist, vol. XXXV., No. 10, pp. 151, 153. Walkom, 1925, Papers and Proc. Roy. Soc. Tasmania for 1924, p. 87.

Observations.—The long linear leaves of *Phoenicopsis* are represented in the present series by poorly developed but undoubted examples, mostly fragmentary. An unusually complete one is that here figured.

In passing, one may note that, in revising and placing the palaeontological collections at the National Museum, it was interesting to see that the former Director, Sir Fredk. McCoy, had labelled some Tasmanian examples of typical leaves of the above species as "*Zeugophylites*," for we remember that in 1847 he had confused the leaves of *Noeggerathiopsis Hislopi* with Morris' *Zeugophyllites*, as it was then termed.

Dimensions.—The figured specimen from Bacchus Marsh has a length of 32 mm., whilst its greatest width is 4.5 mm.

33 Seward, 1900, p. 260, fig. 45.

Distribution.—Trias : Tasmania (Morris). Rhaetic : Stormberg (Seward), and South America (Szajnocha and Kurtz). Jurassic : Walloon Series : Queensland (Walkom) ; also Tasmania.[34]

Phoenicopsis Feistmanteli, nom. mut.

Plate XII., figs., 31, 31*a*.

Podozamites lanceolatus (non Lindley and Hutton sp.), Feistmantel, 1877, Palaeontologia Indica, ser. XI., vol. II., pt. 2, p. 91, pl. III., figs. 7–14 ; pl. IV., figs. 1–10.

Observations. The above form, described by Feistmantel as *Podozamites lanceolatus*, Lindley and Hutton sp. cannot be referred to that species, as already pointed out by Prof. Seward,[15] who further suggests its relationship to *Phoenicopsis*, in the following words :—"The specimens figured by Feistmantel from Upper Gondwana rocks in India as *P. lanceolatus* (fig. 813), should, I am inclined to think, be assigned to *Phoenicopsis*."

Feistmantel records the species as pretty frequent in the Jabalpur group of India (equivalent of Upper Lias to Lower Oolite).

The leaves are slenderer than in *P. elongata*. The apex is acuminate, and the venation parallel and rather closely spaced. In some instances there is a median ridging which is merely a longitudinal folding of the leaf.

Fragments fairly abundant in the present series.

Genus—Psygmophyllum Schimper, 1870.

Psygmophyllum Fergusoni, sp. nov.

Plate XII., fig. 39 ; plate XIII., figs. 44, 45.

Description.—The remains of these leaves are not complete, but there is sufficient to show that it was flabellate, with crenate to wavy margin. The veins are parallel for the most part, with occasional distinct anastomosing and also dichotomous branching. The veins are stout, and are seen in the negative condition as deeply incised lines with a ridge between. The lamina itself was finely lineated with secondary or merely superficial veins.

Dimensions. The veins are about ·5 mm. to 1 mm. apart. Width of lamina preserved, 21 mm. ; length, 31 mm.

Comparisons and Observations.—The "*Cyclopteris*" *crenata* of Brauns,[36] which was described from the Rhaetic of Brunswick, Germany, is a somewhat similarly flabellate leaf to ours, but the

34 In a letter received in 1912, the late Mr. W. H. Twelvetrees wrote me that *Phoenicopsis elongatus* is found abundantly throughout the Mesozoic in Tasmania.
35 Seward, 1919, p. 455.
36 Brauns 1862, p. 52, pl. XIII., fig. 8. ? *Psygmophyllum crenatum*, Brauns, sp., Seward, 1919, p. 88.

edge is more distinctly crenate and the veins are nearly 3 mm. apart. Otherwise it approaches the present species more closely than any other described form.

The leaves are distinct from those of *Ginkgoites* and *Ginkgophyllum*, which have divergent and dichotomous veins and do not anastomose. The type species of *Psygmophyllum* is "*Noeggerathiopsis*" *flabellata* Lindley and Hutton.[37]

The rigidity of the leaf and veins in the above specimens, and the acute dichotomy of the venation are strong evidence in favour of its relationship with the Ginkgoales and not with *Chiropteris*, to which genus Newell Arber[38] has referred a New Zealand species almost identical with the above. In the same report Newell Arber has named the South Australian (Leigh's Creek) specimen, which Etheridge, jun., described as *Anthyopsis* sp.,[39] *Chiropteris Etheridgei* sp. nov.

Another form somewhat related to *P. Fergusoni*, from the Trias (Ipswich Series) of Queensland, was described by Carruthers[40] as *Sphenopteris cuneata*. This has a shorter and broader leaf, as the name denotes.

Psygmophyllum is known from rocks as early as the Devonian, and the genus persists into the Rhaetic, if Brauns and Newell Arber's species are included.

CONIFERALES.

Fam. Cupressineae.

Genus Brachyphyllum Brongniart, 1828.

Brachyphyllum crassum T. Woods.

Plate XIII., fig. 47.

Brachyphyllum australe, var. *crassum* T. Woods, 1883, Proc. Linn. Soc. N.S. Wales, vol. VII., pt. I., p. 159, pl. V.

Brachyphyllum crassum T. Woods, R. Etheridge jun., 1892, Geol. and Pal. Queensland, p. 385, pl. XVIII., fig. 2.

(?) *Palissya australis* McCoy, Chapman, 1908, Rec. Geol. Surv. Vict., vol. II., pt. IV., p. 218, pl. XXXV., fig. 2.

Brachyphyllum crassum T. Woods, Walkom, 1917, Queensland Geol. Surv., Publ. No. 259, p. 25, pl. IX., fig. 1.

Observations. The specimen now figured appears to be a terminal shoot, which bears short, cordate leaves with acuminate

37 Lindley and Hutton, 1832, pls., XXVIII., XXIX.
38 Newell Arber, 1917, p. 27, pl., III., fig. 8.
39 Idem, 1917, p. 28.
40 Carruthers, 1872, p. 355, pl. XXVII., fig. 5, Shirley, 1898, p. 24, pl. XXIII.

and sometimes spinose apices. Fragments of leaves in the surrounding matrix suggests *Elatocladus*, but these may or may not represent the leaves of the basal part of this branchlet. The acuminate leaflets show a close resemblance to the shape of the cone-scales of *Araucarites*, but are minute in comparison. On the whole it seems more advisable to regard it as a terminal branch of the *Brachyphyllum* type, of which the Jurrassic *B. gippslandicum* McCoy, is another closely related form. The material of all our Australian Mesozoic examples of this and allied genera is too meagre for an accurate description, but in the advent of a more complete series, this would form an interesting group of fossil plants to decipher.

On examining the figured type of T. Woods' *B. crassum*, Mr. R. Etheridge, jun., found the leaves "terminated upwards in a short mucro".[41] In this character it agrees with the present specimen.

Distribution.—Tenison Woods records *B. crassum* from the Ipswich Series (Triassic); Tivoli Mine. It also occurs in the Walloon Series (Jurassic) of Clifton Colliery, Walloon and Rosewood (Etheridge, jun. and Walkom).

CONIFERALES, incertae sedes.

Genus Elatocladus Halle, 1913.

Elatocladus conferta Oldham and Morris sp.

Plate XII., fig. 37; Plate XIII., fig. 46.

Cunninghamites confertus Oldham and Morris, 1863, Palaeontologia Indica, vol. I., pt. I., pl. XXXII., fig. 10.

Palissya conferta Phd. and Morr. sp., Feistmantel, 1877, Ibid., ser. II., vol. II., pt. II., p. 137, pl. XLV., figs. 4–8, 8*a*; pl. XLVIII., fig. 4.

Palissya australis McCoy, in Stirling, 1900, Notes on the Fossil Flora of South Gippsland. Rep. on Vict. Coal-fields, No. 7., Dept. of Mines, Vict., pl. III., figs. 8, 9. Chapman, 1908, Rec. Geol. Surv. Vict., vol. II., pt. 4, p. 218, pl. XXXV., figs, 4, 5.

Elatocladus conferta Old. and Morr. sp., Newell Arber, 1917, New Zealand Geol. Surv., Pal. Bull. No. 6, p. 58., pl. L., figs., 1, 3; pl. VI., fig. 4; pl. VIII., fig. 6.

Description. The present examples include a stem with three leaflets attached to one side (fig. 37), found in the red ironstone of the trench at Bacchus Marsh; and also a detached leaflet, highly carbonized, found on the softer, whitish pipe-clay bed. In fig. 37 the stem is thick and slightly imbricated as though the foliage had been stripped off, whilst there are three leaves still remaining, which

41 Etheridge, jun., 1892, p. 385.

compare closely with those from the Rajmahal beds of India, referred by Oldham and Morris to *Cunninghamites confertus.* Feistmantel has described further Indian specimens as follows: "Branches distichous, alternate, furnished with leaves; leaves broader, shorter, at the base constricted, acuminated, on a decurrent cushion, sessile, spirally disposed, but imitating the form of a comb (fructification unknown)."

Observations.—The generic name of *Elatocladus* was given by Halle to include sterile shoots of conifers like that of *Palissya* and *Taxites.* Halle included *Palissya australis* of McCoy in the same genus, as a synonym of *Elatocladus conferta* Oldham and Morris.

Distribution.—The Victorian forms referred to occur in the Jurassic of South Gippsland. Arber's specimens are from the Rhaetic to Middle Jurassic of New Zealand.

Genus—Raritania Hollick and Jeffrey, 1909.

(?) Raritania victoriae, sp. nov.

Plate XIII., figs. 49, 50.

Description.—These examples consist of slender, dichotomously branched axes, which are gracefully curved, and at first sight resemble the remains of *Baiera* (*Jeanpaulia*) *Lindleyana* of Schimper. The edges of the axes are seen, however, to carry what appear to be minute prickle-leaves. The distinguishing feature of the present species is the graceful curvature of the branches and axis, which in *Raritania gracilis*, of the Cretaceous of New Jersey and Kreischerville, consist of straight, divergent branches thrown off from the main axis at an acute angle.

The shoot here figured is about 11mm. in length and the axis is .5mm. in width. The stem is very finely striate.

Observations.—On account of the uniqueness of the above species, the reference to the North American genus, *Raritania*, is here regarded as provisional. Further examples may prove its relationship with *Baiera* rather than with *Raritania.*

SEEDS, incertae sedis.

Genus—Microtesta, nov.

Microtesta triassica, gen. et. sp. nov.

Plate XII., fig. 38.

General Characters.—The minuteness, the ovate to subspherical form, and absence of keels or salient points of attachment prevents the reference of this fossil seed to any genus or group of uncertain position already described.

Description.—This type of small seed-like body is quite abundant in the red ironstone shale of the *Schizoneura* bed. On one slab, from which the figure was taken, I counted eight separate specimens. This seed must have had a thin but evidently tenacious covering, and the shrinkage of the mud during its consolidation caused the seeds to be now easily detached. Remains of *Schizoneura* are commonly associated in the slab examined. The seeds are very minute and average about .5mm. in their longest diameter. They are sub-ovate, depressed and slightly hollowed on one side, as if indicating a place of slight attachment. The surface is finely reticulated with a polygonal meshwork.

FOSSIL WOOD, indeterminate.

Plate XIII., fig. 42.

An interesting, though rather unsatisfactory specimen as regards preservation, is found in this series. It has a wrinkled and fibrous structure, and the exposed surface is seen to be partially covered with small barnacle-like bodies. After sifting the evidence, one has to conclude that this latter structure is inorganic and may be referred to the cone-in-cone structure so often found in mud-stones originally rich in calcareous matter. In this specimen the weathering of the cones, gives the further illusion of separate valves closely fitting together.

The specimen of fossil wood measures about 12cm. in length and 4cm. in the widest part. The cones have a height of about 7mm.

IV.—LIST OF PLANTS HEREIN RECORDED; WITH THE RANGE IN TIME OF GENERA AND SPECIES.

Genus.	Species.	Range.
PHYLLOTHECA	.. .. ..	Permian (India, South Africa, South America, Australia) Triassic (Australia)
	P. indica Bunbury	Permian (India) Triassic (Australia—Victoria)
	P. australis Brongn.	Permian (Australia—New South Wales and Tasmania Triassic (Australia—New South Wales, Queensland and Tasmania)
SCHIZONEURA	.. .. ..	Base of Permian (India) Top of Permian (South Africa, Australia —New South Wales) Triassic (Australia—New South Wales, Queensland and Victoria) Rhaetic (South Africa)

IV.—List of Plants—*continued.*

Genus.	Species.	Range.
	S. microphylla sp. nov.	Triassic (Australia—Victoria)
Coniopteris	.. .. ..	Triassic (Germany, Australia—Queensland and Victoria) Jurassic (England, Australia and New Zealand Cretaceous (North America and Greenland)
	C. delicatula Shirley sp.	Triassic (Australia—Queensland and Victoria)
Thinnfeldia	.. .. ..	Triassic (Australia—New South Wales, South Australia, Tasmania, Queensland and Victoria ; South Africa, India, and South America) Rhaetic (New Zealand) Lias (Hungary) Jurassic (England, France, Germany, India, Italy, Australia—New South Wales and Victoria)
	T. Feistmantelli Johnston	Triassic (Australia—Queensland, Tasmania, South Australia and Victoria Rhaetic (Argentina and New Zealand) Jurassic (New Zealand, Australia—Queensland and Victoria)
	T. lancifolia Morris sp.	Triassic (Australia—Queensland, and Victoria) Rhaetic (New Zealand and Argentina) Mesozoic (Australia—Tasmania) Jurassic (Australia—Queensland)
	T. odontopteroides Morris sp.	Triassic (Australia—Queensland, New South Wales, South Australia, and Victoria ; India) Rhaetic (Argentina, China, South Africa, America and Europe) Jurassic (Australia—Victoria and New South Wales)
Taeniopteris	.. .. ..	Upper Carboniferous (France) Permian (Thuringia, Lebach, Alsace, Virginia) Triassic and Rhaetic (Germany, South Africa, Argentina, China, Australia and New Zealand) Jurassic (England, Arctic Region, Poland, India, Japan, China, New Zealand and Australia) Wealden (North Germany and England)
	T. wianamattae, Feistm	Triassic (Australia, South Australia, Queensland, New South Wales and Victoria)
Ptilophyllum	.. .. ..	Triassic (Australia—Queensland [flowers], and Victoria [leaves])

IV.—List of Plants—*continued*.

Genus.	Species.	Range.
Ptilophyllum (*continued*)	.. .. ..	Jurassic (England, India, Grahamland, New Zealand, Australia—Queensland and Victoria [leaves])
		Wealden (North Germany).
		Cretaceous (Greenland)
	P. pecten Phillips sp.	Triassic (Australia—Victoria)
		Jurassic (England, India, Australia—Queensland and Grahamland)
		Lower Cretaceous (Greenland)
Ginkgoites	.. .. ..	Trias and Rhaetic (South Africa, Australia—Queensland and Victoria)
		Jurassic (England, Scotland, Spitzbergen, North Germany, Turkestan, Japan, Oregon, Australia—Victoria)
		Cretaceous (Greenland)
		Tertiary-Eocene, Miocene and later. (I. of Mull, Greenland, North Italy, France, North America)
	G. digitata, Brongn. sp.	Triassic (Australia—Queensland)
		Jurassic (Great Britain, Franz Josef Land, Oregon, Japan, Australia—Victoria)
		Mesozoic (Australia—Tasmania)
		Up. Jurassic or Wealden (Spitzbergen)
Baiera ..	.. .. ..	Permian (France)
		Triassic (Switzerland, Sweden, Australia—Queensland)
		Rhaetic (Japan and New Zealand)
		Jurassic (England, Spitzbergen, China, Australia—Victoria)
		Lower Cretaceous (Dakota)
	B. darleyensis sp. nov.	Triassic (Australia—Victoria)
Stachyopitys	.. .. ..	Triassic (Australia—Queensland and Victoria)
		Rhaetic (Franconia, South America, and South Africa)
	S. annularioides, Shirley	Triassic (Australia—Queensland and Victoria)
		Jurassic (Grahamland)
Antholithus	.. .. ..	Triassic (Australia—Victoria)
		Rhaetic (Scania)
		Jurassic (England)
Phoenicopsis	.. .. ..	Triassic (Australia)
		Rhaetic (South Africa)
		Jurassic (North Germany, Franz Josef Land, Siberia, India and Australia)
	P. elongatus Morris sp.	Triassic (Australia—Victoria and Tasmania)
		Rhaetic (South Africa)

IV.—List of Plants—*continued*.

Genus.	Species.	Range.
Phoenicopsis (*continued*)	.. .. ..	Jurassic (Australia—Queensland and Tasmania)
	P. Feistmanteli sp. nov.	Triassic (Australia—Victoria) Jurassic (India)
Psygmophyllum	.. .. ..	Devonian (Ireland, Norway, and Newfoundland) Carboniferous (England and Spitzbergen) Permian (France, Russia, Germany, South Africa, Australia—New South Wales) Triassic (Australia—Victoria)
	P. Fergusoni sp. nov.	Triassic (Australia—Victoria)
Brachyphyllum	.. .. ..	Triassic (Australia—Victoria) Rhaetic (New Zealand) Jurassic (England, France, India, Australia—Victoria) Lower Cretaceous (Portugal and North America)
	B. crassum T. Woods	Triassic (Australia—Queensland and Victoria)
Elatocladus	.. .. ..	Triassic (Australia—Victoria) Rhaetic (Scania and New Zealand) Jurassic (England, India, Australia, Grahamland and New Zealand) Cretaceous (Westphalia, Moravia, Bohemia, Bulgaria, Greenland and North America
	E. conferta Oldh. and Morr. sp.	Triassic (Australia—Victoria) Rhaetic (New Zealand) Jurassic (New Zealand, Australia—Victoria)
Raritania	.. .. ..	Cretaceous (New Jersey)
	Raritania victoriae sp. nov.	Triassic (Australia—Victoria)

In digesting the foregoing summary of occurrences, we find that, amongst genera older than the Trias, there are five counts.

Of the Trias and Rhaetic, there are thirteen counts.

The genera younger than the Trias have eleven counts (excluding a doubtful record).

Thus, the balance of evidence as to the age of the flora removes it conclusively from the *Gangamopteris* horizon, and places it in the Trias, with a strong leaning towards the Jurassic facies.

V.—GEOGRAPHICAL RELATIONSHIPS OF THE FOSSILS.

A brief examination of our knowledge of the distribution of the various kinds of plants comprised in the present series, shows some striking points worthy of notice.

The equisetaleans, *Schizoneura* and *Phyllotheca* are apparently confined to the old Gondwana continent. Thus, *Schizoneura* appeared in Permian times in both South Africa and Australia, and persisted into the Triassic and Rhaetic in South Africa and Australia (New South Wales, Queensland and Victoria).

Phyllotheca had a similar and even wider distribution, but still over the tract of Gondwanaland. Its habitats in Permian time extended from India and Australia to South Africa and South America. In the Triassic period it was apparently confined to Australia (New South Wales, Queensland, Victoria and Tasmania): whilst the Rhaetic occurrence in New Zealand shows a later penetration into that area. Although not found in this series, we may note that the related *Equisetites* is known from beds as old as the Trias in Europe, the older Permian and Carboniferous records being more or less doubtful calamiteans. The appearance of *Equisetites* in the Australian flora as early as the Triassic (Ipswich series) shows its universal distribution in the early Mesozoic; though after remaining as a fairly abundant constituent of the southern flora until Jurassic times, it seems to have suddenly retreated to Europe, with the exception of the remnants still found living in Java, the West Indies and South America (Buenos Aires and Chili).

The ferns include *Coniopteris* (presumably a tree-fern), which is a genus known to have lived in Europe during Triassic times; in England, Australia and New Zealand during Jurassic times; and in North America and Greenland, probably, in Cretaceous times; *Thinnfeldia* was a late Gondwanaland development, as it is well distributed throughout the Trias and Rhaetic of India, Australia, New Zealand, South Africa and South America. In Jurassic times it extended its range into Europe, and it also doubtfully lived on in the North American Cretaceous.

Unlike many other Australian types of fossil plants, *Taeniopteris* had already established itself in the European and North American floras in Upper Carboniferous times, occurring in France and in Missouri. In the Permian it still flourished in those areas; persisting in England, Europe and the Arctic regions, through Jurassic times and even into the Wealden. During the Triasso-Rhaetic period *Taeniopteris* was well established in the later Gondwana flora in India, Australia, New Zealand, South Africa, China and South America. It is a prominent genus in most southern Jurassic floras, in which period it suddenly dies out, though still persisting in Europe into the Wealden.

The only representative of the Cycadales, *Ptilophyllum*, is another well-distributed genus, and appears first in the Southern Hemisphere, in Queensland, and now in Victoria. In New Zealand it is found in later, Jurassic, rocks, similar in its time occurrence in

England, Graham Land and India. It persists also in southern areas in Jurassic times, as it is found in the Walloon series in Queensland, as well as in New Zealand. Its latest appearance is in the Wealden of Upper Germany and the Cretaceous of Greenland. This fluctuating distribution is at least puzzling and suggests some curious palaeogeographical questions.

The Ginkgoales, represented by *Baiera* as the older type, and *Ginkgo* or *Ginkgoites*, range from the Permian till to-day. *Baiera* itself occurs in the Permian of France. In the Trias-Rhaetic it is found both in Europe and the later Gondwana areas. The Jurassic period saw it extending to North America, where it persisted till Lower Cretaceous times.

The type of the living *Ginkgo* dates from the Trias of Victoria and the Rhaetic of South Africa.

Amongst the genera of uncertain position, but allied to the Cycadales or Ginkgoales, are *Phoenicopsis* and *Psygmophyllum*. The genus *Phoenicopsis*, like several other generic types enumerated here, appears to have commenced its existence in the Southern Hemisphere, as it occurs in the present Triassic series and also in the Rhaetic of South Africa. It later made its appearance in Europe, in the Jurassic, at which time it was also a well known component of the Australo-Indian series.

Psygmophyllum.—The range of this genus (in a less restricted form), is given as from Devonian to Permian. It is interesting to note the geographical distribution of the genus, which in Devonian and Carboniferous times was confined to Europe and North America. It then apparently spread to Gondwanaland in the Permian, where it is found in the South African and probably Australia (New South Wales) series of rocks. This present occurrence, in the Trias of Victoria, of examples quite typical of Lindley and Hutton's Carboniferous fossils from the English Newcastle Coal Measures, is therefore highly interesting as a record of persistence into the Mesozoic.

Of the Coniferales, *Brachyphyllum* has hitherto been confined almost entirely to the Jurassic rocks of England, France, India and Australia: but it has survived into the Lower Cretaceous of Portugal and the Dakota Group of North America. The oldest record, that of the present, Triassic occurrence at Bacchus Marsh, is further confirmed by the discovery of the genus by Newell Arber in probable Rhaetic rocks of Otago, New Zealand.

In *Elatocladus*, which according to Halle[42] should include "sterile Coniferous branches of the radial or dorsi-ventral type, which do not show any characters which permit them to be included in one of the genera instituted for more peculiar forms," we have a generic type similarly found in the Rhaetic of New Zealand as

42 Halle, 1913, vol. III., pt. XIV., p. 83.

well as in Sweden. The present occurrence extends the time range to the Trias. In Jurassic times it was a most important component of the later Gondwana flora of India, Australia, New Zealand and Graham Land, and also persisted in the European flora of that time. In the Cretaceous period it seems to have been restricted to North America and Europe.

The genus *Raritania*, only provisionally recorded here, in the Trias, is a North American Cretaceous type. Any further discoveries of this particular form in Australia will be awaited with interest.

VI. CONCLUSIONS.

From a consideration of the foregoing descriptions of plant remains from the *Schizoneura* bed of the trench in the Council Paddock at Bald Hill, it will be seen that the evidence is in favour of a Triassic age for this horizon.

It is interesting to note McCoy's close determination of the age of the bed, in spite of meagre data, for he recognised its Triassic affinities, even in the face of the inverted field relations as misunderstood at the time, that is to say, as regards the supposition of these beds occurring *under* the *Gangamopteris* Sandstone of Bacchus Marsh. One of the greatest triumphs of palaeontology is the fixing of exact horizons by an accurate valuation of the fossil remains; and in this direction McCoy not only did pioneering work, but drew lasting conclusions carried out on what one would now consider only poor material. As Dr. T. S. Hall more than once remarked to me, regarding modern criticisms, "I should not wonder if McCoy's earlier determinations came out right after all."

There still remains much to be done, however, in the way of collecting the plant remains of this Triassic bed. This series of specimens, though interesting, cannot be regarded as complete, for much might still be gathered as to essential structural portions of the plants discussed, fragments only of which are represented in the present collection.

What has already been discovered, as set forth here, is sufficient to show how important an horizon it is, for many unique kinds of plants have been brought to light since the record of McCoy's *Schizoneura* and *Ptilophyllum*.

Looking at the subject broadly, the Triassic period was a kind of "trying-out" time when the Upper Palaeozoic Flora or Lower Gondwana Series still struggled on, until it became a mere skeleton of its former self, to be absorbed by the incoming richer Jurassic or Upper Gondwana Flora.

The recent exhaustive work of Dr. A. B. Walkom on the Mesozoic Flora of Queensland, the classic volumes on Fossil Plants by Professor A. C. Seward, and the Monograph of Mesozoic Plants of New Zealand by the late Dr. Newell Arber, have all proved of the greatest value to aid in the comparison of types and structure found in the present series. Thanks to the foresight of Sir Fredk. McCoy, the Library of the National Museum contains many otherwise inaccessible works of the older authors, without reference to which a full comparison of the Bacchus Marsh Triassic plants could scarcely have been made.

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NOTE.

Since this paper went to press the present writer, in conjunction with Miss Cookson, B. Sc., has published "A Revision of the 'Sweet' Collection of Triassic Plant Remains from Leigh's Creek, South Australia". Trans. Roy. Soc. S. Australia, vol. L. 1926, pp. 163-178, pls. XIX.-XXIV. The species in common between the two localities (Leigh's Creek and Bacchus Marsh) are as follows:—

Thinnfeldia Feistmantelli Johnst.
Thinnfeldia lancifolia Morris sp.
Taeniopteris wianamattae Feistm. sp.

Although the two floras have little in common, they both give the same chronological result, viz., Bacchus (upper flora), "Triassic, with a strong leaning towards the Jurassic facies", and Leigh's Creek, "Triassic, the flora having a fair proportion of precocious Jurassic types."

EXPLANATION TO PLATES.

Plate X.

Fig. 1.—*Schizoneura microphylla* sp. nov. Cast of stem, with traces of leaves. Paratype. Natural size.

Fig. 2.—*S. microphylla* sp. nov. External surface with attached leaflets. Paratype. Natural size.

Fig. 3.—*S. microphylla* sp. nov. A slender stem, showing nodes and leaflets. Paratype. Natural size.

Fig. 4.—*Phyllotheca indica* Bunbury. Stem with closely set joints and remains of whorled leaflets. × 3.

Fig. 5.—*Schizoneura microphylla* sp. nov. Nodal diaphragm. Paratype. × 2.

Fig. 6.—(?) *Phyllotheca indica* Bunbury. Rhizome with attached tubers. × 3.

Fig. 7.—*Schizoneura microphylla* sp. nov. Pith cast of stem, to the margin of which, at a node, remains of attached leaves are seen. Cotype. Natural size.

Fig. 8.—*S. microphylla* sp. nov. Pith cast, with traces of foliage at the nodes. Paratype. × 2.

Fig. 9.—(?) *Phyllotheca indica* Bunbury. Rhizome with attached tubers. × 3.

Fig. 10.—*Schizoneura microphylla* sp. nov. Stem and part of two nodal diaphragms. Paratype. × 2.

Fig. 11.—*S. microphylla* sp. nov. Leaflet from slab, near specimen figure 10. Paratype. × 2.

Fig. 12.—*S. microphylla* sp. nov. Short joint showing grooved and interlineated stem, with leaves attached. Paratype. × 2.

Plate XI.

Fig. 13.—*Schizoneura microphylla* sp. nov. Part of a cyclet of leaves. Paratype. × 2.

Fig. 14.—*S. microphylla* sp. nov. External surface of stem, with node and basal leaf imprints. Paratype. × 2.

Fig. 15.—*Phyllotheca indica* Bunbury. Stem with displaced nodes. × 4.

Fig. 16.—*Phyllotheca australis* Brongniart. Base of joint and leaf-sheath. Natural size.

Fig. 17.—*Schizoneura microphylla*, sp. nov. Leaves attached to nodal diaphragm. Paratype. × 2.

Fig. 18.—cf. *Schizoneura*. Epidermis of (?) rhizome, showing pits of rootlet attachment. × 2.

Fig. 19.—*Thinnfeldia odontopteroides* Morris sp. Rachis with three pinnules. × 2.

Fig. 20.—*Thinnfeldia lancifolia* Morris sp. A characteristic pinnule. X 2.

Fig. 21.—*T. lancifolia* Morris sp. A pinnule. × 2.

Fig. 22.—*Antholithus* sp. × 2.

Fig. 23.—*Antholithus* sp. × 2.

Fig. 24.—(?) *Coniopteris delicatula* Shirley sp. × 2½.

Fig. 25.—*Stachyopitys cf. annularioides* Shirley. × 2.

Fig. 26.—*Antholithus* sp. × 2.

Fig. 27.—*Phoenicopsis elongatus* Morris sp. × 2.

Fig. 28.—*Coniopteris delicatula* Shirley sp. Apex of frond. × 2½.

Fig. 29.—*Ginkgoites digitata* Brongniart sp. × 2.

EXPLANATION TO PLATES *continued*.

PLATE XII.

Fig. 30.—*Thinnfeldia Feistmantelli* Johnston. (T. S. Hall coll.) Rachis and pinnules, showing venation. × 2.

Fig. 31.—*Phænicopsis Feistmanteli* sp. nov. (Types as figured by Feistmantel, Pal. Ind., 1877). Two fragmentary leaves. × 2.

Fig. 31A.—*P. Feistmanteli* sp. nov. Apical portion of leaf. × 2.

Fig. 32.—*Baiera darleyensis* sp. nov. × 2. Paratype.

Fig. 33.—*B. darleyensis* sp. nov. × 2. Paratype.

Fig. 34.—*B. darleyensis* sp. nov. × 3. Holotype.

Fig. 35.—*Schizoneura microphylla* sp. nov. Strobil at terminal of a shoot. Cotype. × 6.

Fig. 36.—*Ptilophyllum* (*Williamsonia*) *pecten* Phillips sp. A frond; the original of McCoy's *Ptilophyllum Officeri*. × $2\frac{1}{2}$.

Fig. 37.—*Elatocladus conferta* Oldham and Morris, sp. Axis with three leaflets. × 6.

Fig. 38.—*Microtesta triassica* gen. et sp. nov. Holotype. × 52.

Fig. 39.—*Psygmophyllum Fergusoni* sp. nov. An imperfect leaf. × 2.

Fig. 40.—(?) Cycadaceous fruit. Natural size.

Fig. 40A.—Cycadaceous fruit. Enlarged view of one of the enclosed megaspores. × 4.

PLATE XIII.

Fig. 41.—(?) Cycadaceous fruit in matrix. Photograph. Natural size.

Fig. 42.—Wood, indeterminate. Encrusted with concretionary cone-in-cone structure. Photograph. Natural size.

Fig. 43.—*Schizoneura microphylla* sp. nov. Photograph of pith cast. Paratype. Natural size.

Fig. 44.—*Psygmophyllum Fergusoni* sp. nov. Photograph of Holotype. Natural size.

Fig. 45.—*P. Fergusoni* sp. nov. Enlarged drawing of holotype, to show venation. × 2.

Fig. 46. (?) *Elatocladus conferta* Oldham and Morris sp. Leaflet. × 4.

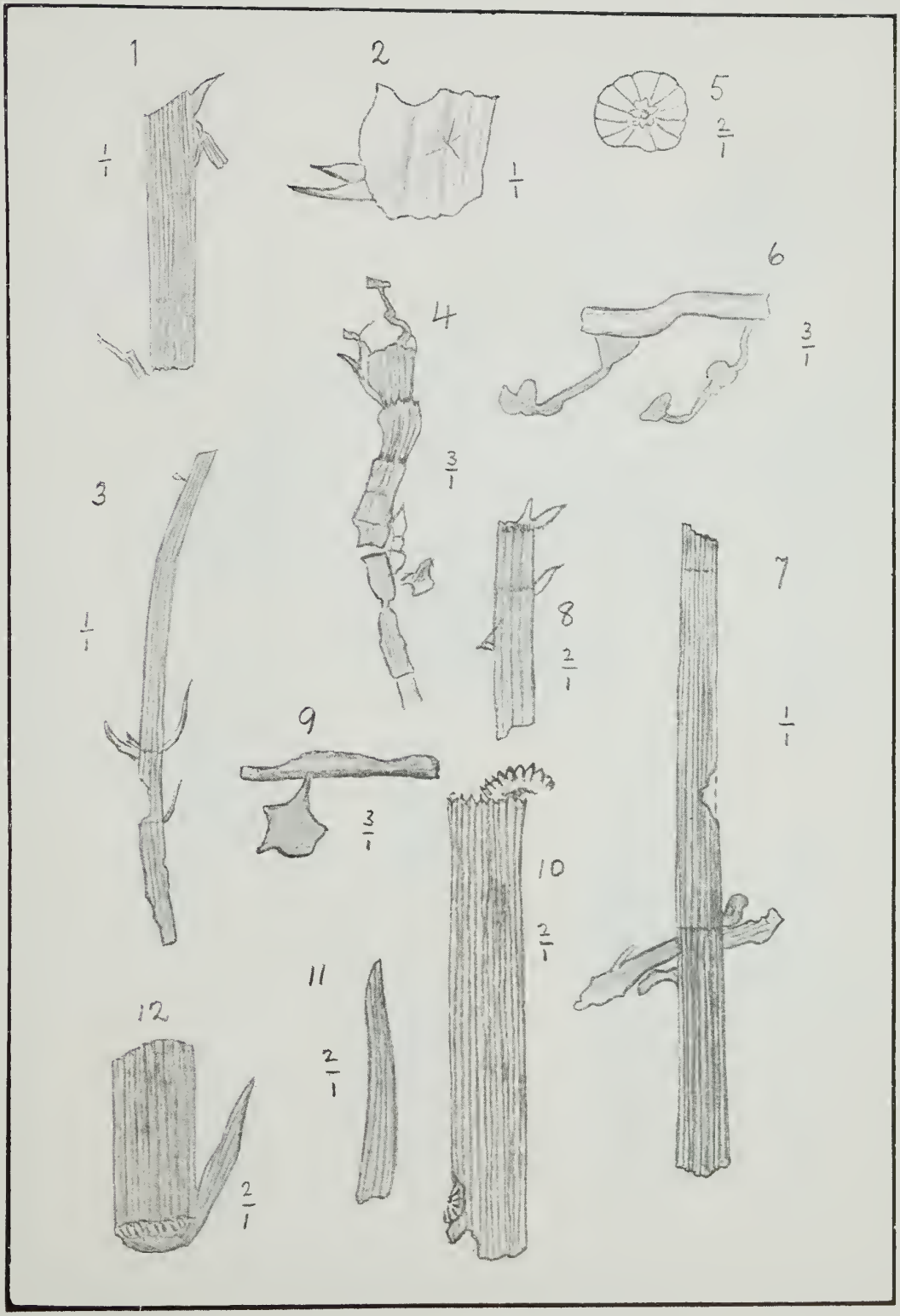
Fig. 47.—*Brachyphyllum crassum* T. Woods. Terminal shoot. × 4.

Fig. 48.—*Schizoneura microphylla* sp. nov. Slender stem with leaflets. Paratype. × 4.

Fig. 49.—(?) *Raritania victoriae*, sp. nov. Enlarged drawing to show the character of the foliage. × 4.

Fig. 50.—(?) *Raritania victoriae*, sp. nov. Photograph of holotype. On the same slab are associated remains of *Schizoneura*. × $\frac{3}{4}$.

Fig 51.—*Taeniopteris wianamattae*, Fiestmantel. Type of *Taeniopteris Sweeti*, McCoy. Natural size.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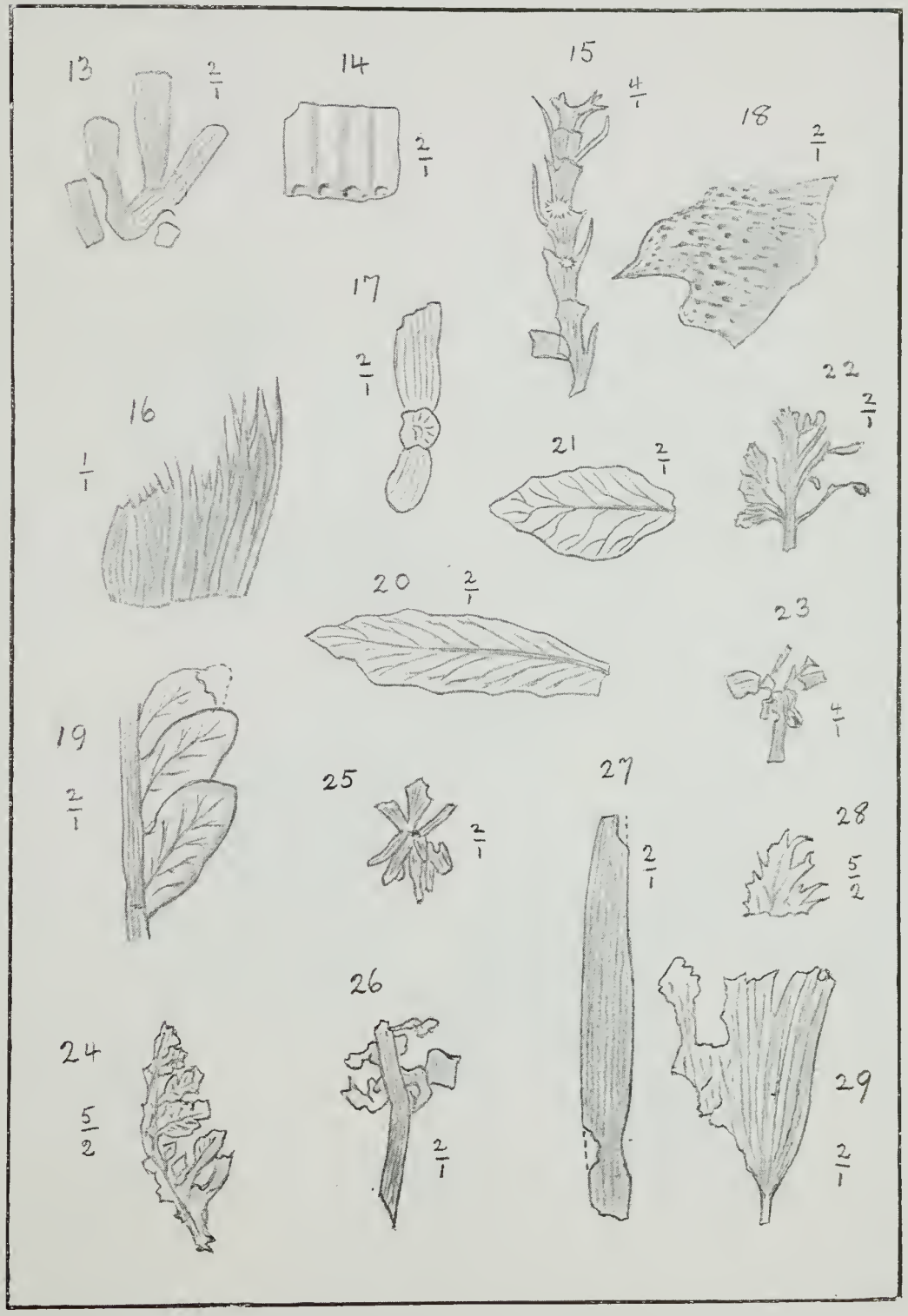
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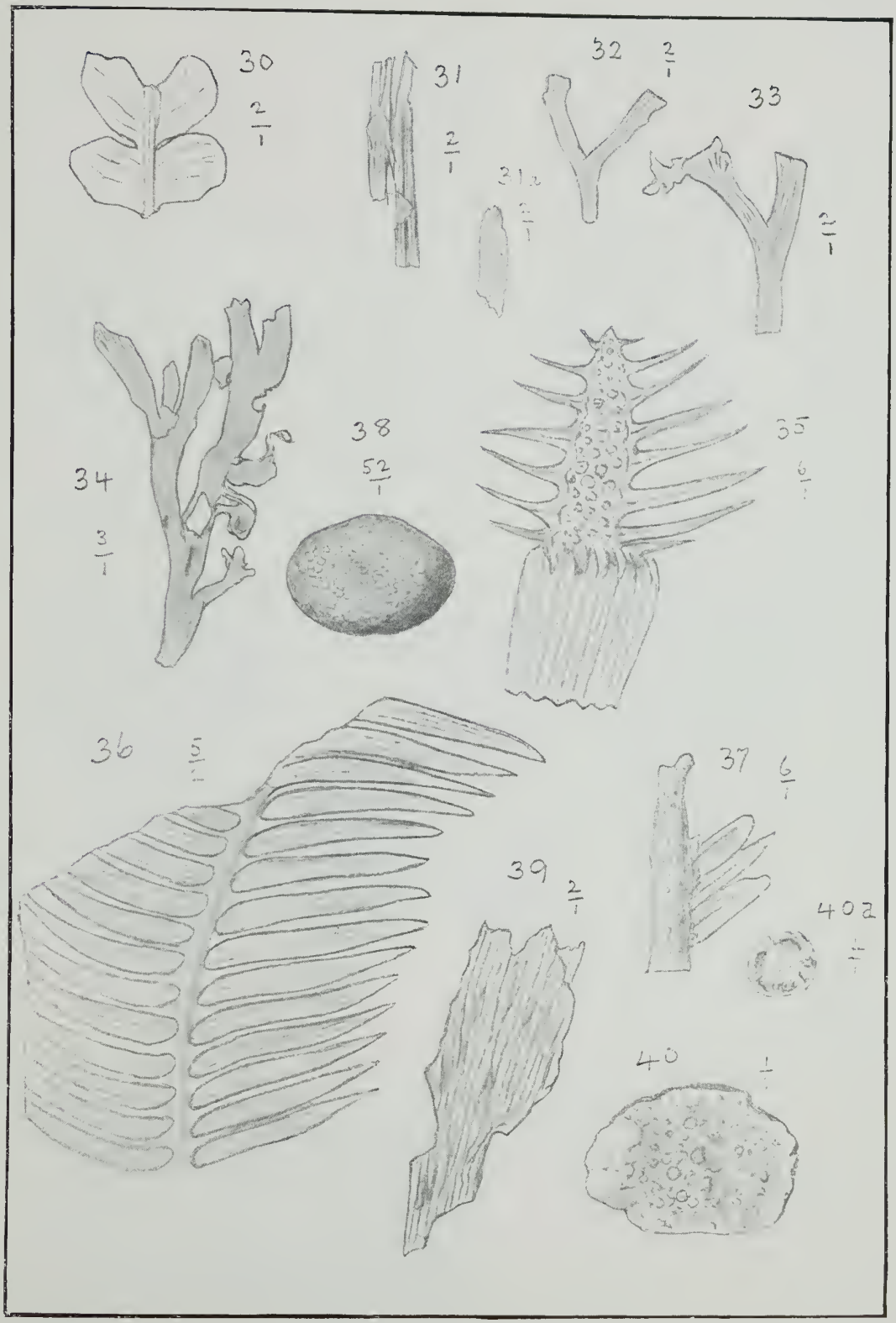
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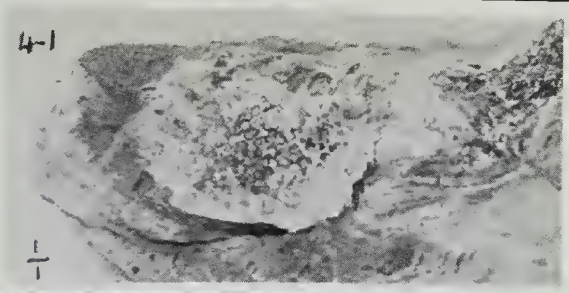
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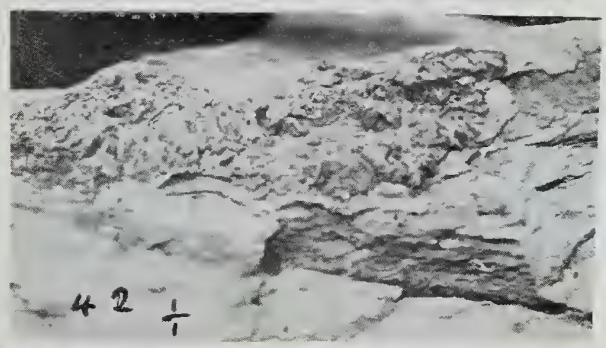
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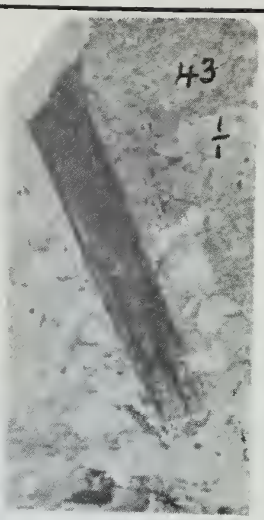
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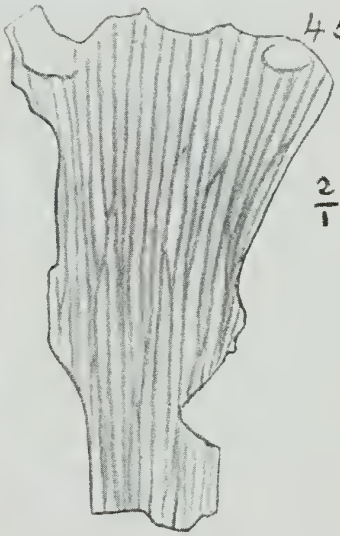
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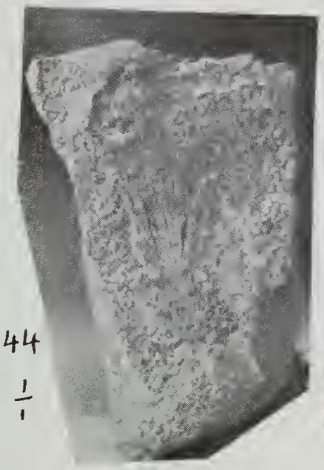
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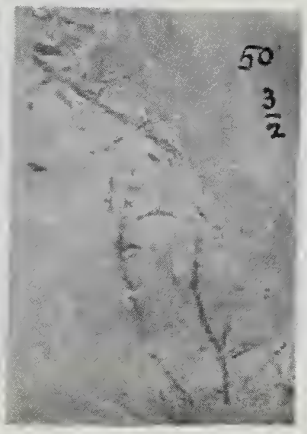
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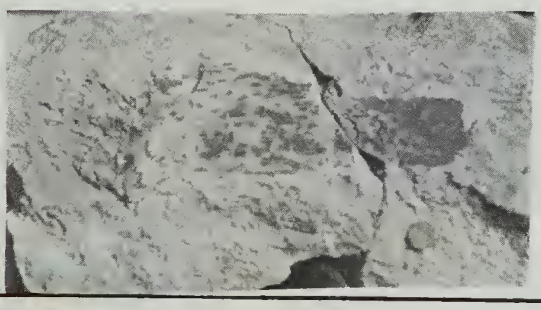
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ON AN ADDITIONAL OCCURRENCE OF BYTHOTREPHIS IN VICTORIA.

By A. H. S. Lucas, M.A., B.Sc.

(Plate XIV.)

I am indebted to the authorities of the National Museum, Melbourne, for the opportunity of describing the following specimen.

Presumably the primitive flora of the world was entirely algal. Other forms appear to have developed from different types of algae. Hence it is of interest and importance to ascertain what types of algae flourished in the earlier times, how they were distributed, and what was their elemental structure. The evidence is fragmentary, and owing to the soft entirely parenchymatous nature of the plants but little of the structure has been preserved and revealed. The occurrence, then, of a specimen of a well grown alga in beds so adapted to the preservation of soft parts that a jelly-fish is shown in nearly its entirety in them, gave hopes that information of value might be furnished as to early algal structure. Unfortunately very little has been gained so far in this regard, but it is interesting to find an alga in the Melbournian Beds of Victoria, apparently identical with one from the Lower Ordovician of North America.

The fossil consists of two main fronds of *Dictyota* habit which diverge as if proceeding from a common attachment. They do not lie flat in one plane but are extended freely as on an undulated surface, seemingly showing that they were imbedded in rapidly accumulating sediment. One often finds recent plants like *Dictyota dichotoma* similarly half sunk in wet sand which has been poured over them by the tide succeeding that which deposited them on the beach. The fronds are compressed, repeatedly dichotomous, with acute axils, the segments not rapidly diminishing in width. Length of frond 78 mm., while the spread of the two fronds occupies a width of 94 mm. The width of the segments average about 3 mm. The length of the longest branch 60 mm. The substance is carbonaceous. A collodion film showed rounded cells loosely grouped with rather thin borders, 79–124μ in diameter (pl. XIII., f. 3).

I venture to identify the form with *Bythotrephis gracilis*, James Hall, described and figured from the Trenton Limestone, in the upper part of the Lower Ordovician of New York.[1]

Hall's description is as follows :—

> " Form slender, flattened, branched; branches compressed, leaflike, subdichotomous, diverging, opposite and alternate ; no visible structure.

1 *Palaeontology of New York*, Vol. I., p. 62, Plate XXI., fig. 1, Albany, 1847.

A Carbonaceous film is all that remains of the fossil. It was probably a succulent marine plant, not unlike Fucus, but of a very slender form and habit."

The alga was obtained from Hoffman's Clay Pit, Brunswick, Melbourne, in the basal part of the Melbournian Beds of the Silurian Series (F. Chapman). It is bedded in a pale blue pyritous sandstone, occurring in intermittent bands in the typical blue mudstone. The sandstone is very fine grained, but the bedding is not well developed, the irregular fracture indicating shallow water conditions. The Museum is indebted for its preservation to Mr. R. Evans, one of the workmen, who had previously found Trilobites and Brachiopods in the clay pit, and who took great care to gather and preserve as much as possible of the specimen.

Mr. F. Chapman has recorded other Victorian algae which he has identified with foreign species of *Bythotrephis*. These are *B. tenuis* James Hall, present in Silurian beds in the Botanical Gardens, South Yarra,[2] *B. intermedia* James Hall, in Silurian beds, South Yarra,[3] both found in the Trenton Limestone of New York; and *B. divaricata* Kidston, from the Tanjilian of Walhalla,[4] described from the Wenlock of Malvern, England.

The generic form *Bythotrephis* then seems to have been dominant in Silurian and Ordovician times in England, North America and Victoria, and we may suspect, throughout the seas of the world. By the apparent simplicity of its structure it seems to have been an elemental or generalised type.

Hall compared it with *Fucus*, a name not so definite in his time as now, but in the absence of any kind of fruit it is impossible to associate *Bythotrephis* with any living genus, even with *Dictyota*, which it resembles in form and habit and which has much simpler modes of reproduction than the present restricted *Fucus*.

It remains to me to acknowledge how greatly I am indebted to Mr. F. Chapman for the help he has given me in drawing up the present record.

EXPLANATION OF PLATE XIV.

Fig. 1.—*Bythotrephis gracilis*, J. Hall sp. Frond, natural size.

Fig. 2.—Portion of the same, twice natural size.

Fig. 3.—Cell structure of the carbonised surface, from a collodion film. The arrow shows the direction of length in the frond. Magnified 104 diameters.

2 [Proc. Roy. Soc., vol. xv. (N.S.), pt. I., 1903, p. 104, pl. xvi., f. 1.
3 Identified by F. Chapman, Nat. Mus., Coll.
4 Rec. Geol. Surv. Vict., vol. iii., pt. 2, 1912, p. 231, pl. xxxviii., f. 1.

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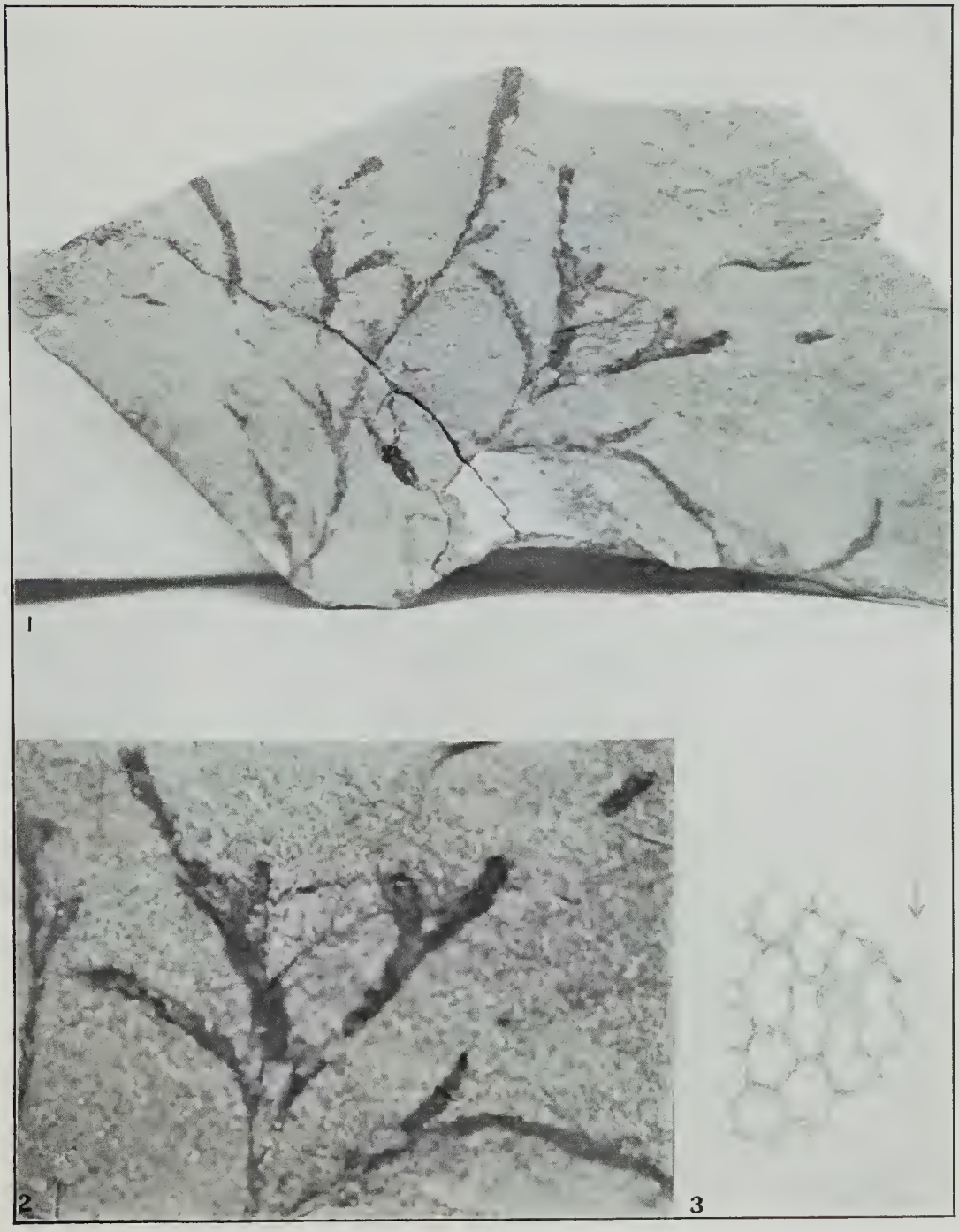
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